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SEISMOLOGICAL OBSERVATIONS AND EARTH PHYSICS.*

By JOHN MILNE, F.R.S., F.G.S.

Introduction.

The chief object of the following paper is to point out the character of the information derived from earthquake investigations which throws light upon the physical nature of the interior of our world and the geomorphological changes in operation on or near its surface. The earthquakes to be considered may be divided into two groups—first, those which disturb continental areas and frequently disturb the world as a whole; and secondly, local earthquakes which usually only disturb an area of a few miles' radius, and seldom extend over an area with a radius of 100 or 200 miles.

These former I shall endeavour to show are the result of sudden accelerations in the process of rock-folding accompanied by faulting and molar displacements of considerable magnitude, whilst the latter are for the most part settlements and adjustments along the lines of their primary fractures. The relationship between these two groups of earthquakes is therefore that of parents and children.

The former, which represent a disturbance, not only of the crust of the world, but also of the homogeneous nucleus it covers, will be referred to as macroseismic disturbances, or large earthquakes; and the latter, which appear to be the shiverings within the crust, will be referred to as microseismic disturbances, or small earthquakes. To avoid confusion it must be mentioned that several observers refer to the world-shaking

* Read at the Royal Geographical Society, November 11, 1902. Map, p. 108.

disturbances as microseismic, the reason, no doubt, being that they are usually recorded at such a great distance from their origins that their vibrations have so far died down in amplitude and increased in period that they cannot be felt or be seen in the traces of ordinary seismographs. Hence the largest earthquakes have been called small. It also must not be overlooked that the term "microseismic" has been used to describe disturbances evidenced by minute and long-continued swingings of pendulums and other apparatus, the cause of which is, in many instances at least, attributable to movements in the atmosphere rather than in the earth.

I. Macroseisms, or Large Earthquakes.

Their Discovery and Observations.

It is difficult to say when it was first observed that the violent movements of a large earthquake gradually changed in character as they radiated, until at a certain distance from their origin, although they could not be felt, evidence of their existence still remained. After the great earthquake of Lisbon, in 1755, the motion of the water in lakes and ponds observed in England, Scandinavia, and North America, although the ground itself was not observed to move, was attributed to pulsations in the soil which had radiated from the coast of Portugal.

Another form of evidence pointing in the same direction has from time to time been furnished by astronomers. Prof. George Darwin, in a Report to the British Association, 1882, refers to the observations of M. Magnus Nyrén, which are described in the Publications of the Imperial Academy of St. Petersburg, February 28, 1878.

On May 10, 1877, M. Nyrén observed disturbances in the level on the axis of the transit at Pulkova. The oscillations had a period of 20 seconds, and their amplitudes varied between 1·5″ and 2″. He attributed this to an earthquake which had occurred $1^h\ 14^m$ earlier at Iquique, and calculated the rate at which the wave-motion was transmitted *through* the earth. It may be mentioned that the amplitudes and periods here given in all probability refer to the large waves which had travelled *round* the world, the smaller preceding waves which had passed through the same having escaped observation.* M. Nyrén also refers to two other oscillations of level observed at Pulkova to distant earthquakes.

Similar alterations in level had been previously observed by M. Wagner and M. Romberg, but these had not been connected with earthquakes, "at least with certainty."

The first instrumental record obtained by the writer of an earthquake which could not be felt, and which, therefore, must have reached

* At the time of this earthquake the writer was on the east coast of Japan, where twenty-five hours after its occurrence the sea rose and fell from 5 to 10 feet.

his station from a great distance, was on March 25, 1884 (see *Trans. Seis. Soc.*, vol. x. p. 6). These earthquakes were subsequently referred to as "slow earthquakes," the period of motion being so long, or the movement so slow, that they could only be observed instrumentally.

It was the consideration of a long series of observations like those just referred to which in 1883 justified the writer in saying that "it is not unlikely that every large earthquake might with proper appliances be recorded at any point on the land-surface of the globe" (see 'Earthquakes,' p. 226. Internat. Scientific Series).

This statement was not realized until six years later, when the late Dr. E. von Rebeur Paschwitz found in the photographic records of the displacements of a horizontal pendulum, established with the expectation of at least detecting the gravitational influence of the moon, abnormal movements which he traced to earthquakes which had originated at great distances from his observing station. A long list of these, with their analysis, is to be found in vol. ii. of the *Beiträge zur Geophysik*, 1895. In the same volume, Von Rebeur makes many references to the work the writer of this paper was at that time engaged upon in Japan, where, with apparatus similar to that employed in Europe, earth-tremors and earth-pulsations were being recorded. In these records, abnormal movements also occurred which corresponded to those observed in Germany. Although this method of recording unfelt movements of the ground was independently reached in two distant countries, the priority of the discovery belongs to Von Rebeur, a man whose loss is to be regretted by all students of geophysics.

From this time seismologists had before them a new field for research, and stations to record world-disturbing earthquakes are now to be found in very many countries. The most complete organization of stations is that working in co-operation with a committee of the British Association. At each of the thirty-eight places named upon the accompanying map (p. 108) there is an instrument similar to that described in the *Geographical Journal*, March, 1896. Every half-year such registers as have been received from these stations are published as a pamphlet, and copies of the same are forwarded not only to those working with the British Association type of instrument, but to other seismologists who desire to have the same. In this way each observer is in a position to analyse the records to which he has contributed from his own standpoint; and where they include observations relating to earthquakes which originated in or near to his own country, he is frequently, in consequence of local knowledge, enabled to make analyses much more completely than they would be made by persons at a distance. The Association also issues an annual report on the observations. This, then, is the position of macroseismic investigations as carried out from Great Britain. We will next consider the results which arise from this work.

On Earth-waves, their Velocity of Propagation and the Bearing of this on the Physical Nature of the World.

When a large earthquake takes place, it seems to propagate a series of waves all through the world and in all directions over its surface.

The first movements to arrive at a distant station (see Fig. 2) are usually spoken of as preliminary tremors, and the group they constitute as the first phase. Their amplitudes are usually to be measured by fractions of a millimetre, and their periods, which are short, usually vary between 0·1 of a second up to 5 seconds, the longer period waves being found at stations remote from an origin. Their velocity within 1000 kilometres of an origin is from 2 to 2·2 kilometres per second, but beyond this distance the apparent average velocity along a chord is about 9 kilometres per second. They pass through a diameter of the Earth in about twenty-two minutes, which implies an average velocity of about 9·6 kilometres per second. They are regarded as being compressional in character. The approximately constant velocity with which they are propagated suggests a nucleus that is approximately homogeneous.

The second phase of motion consists of waves larger in amplitude and longer in period than those in the first phase. These have been regarded as distortional.

Succeeding these, and forming the principal part of a seismogram, are the largest waves. The average periods of these vary between fifteen and thirty seconds, but periods exceeding sixty seconds have been observed. The nature of these waves is still *sub judice*. Some observers are apparently convinced that they represent horizontal displacements, whilst others, which include myself, incline to the opinion that they have an undulatory character, but the tilting is not so great as, until quite recently, has been generally supposed.

Observations made at Kew, Shide, Bidston, and Edinburgh, where the foundations on which the instruments rest are respectively alluvium, chalk, sandstone, and volcanic rock, indicate that if the movements caused by the same series of earthquakes are regarded as horizontal displacements, then there are considerable differences in their amplitudes recorded at these stations, whilst if we regard these movements as tiltings, the records for at least three of these stations are in close accordance. Assuming that this latter result meets with confirmation, it would appear that the large waves of earthquakes pass beneath a country like Great Britain with the character of an ocean swell, causing forced but equal undulations in the heterogeneous crust above.

Observations which are contrary to this view are as follows:—

1. Clinometers have hitherto failed to detect any tilting effects.

2. If it is assumed that the records of horizontal pendulums give angular values for tilting, and from the period of the waves causing

these tiltings and the velocity with which these waves are propagated we calculate their length, we have on the assumption of simple harmonic motion all the elements which are required to calculate the heights of these waves. Now these heights are frequently as much as 1 or 2 feet, and apparently represent accelerations $\frac{1}{50}$ of gravity. The magnitude of these quantities is certainly sufficient to create a suspicion that the angular values assigned to large waves have hitherto been exaggerated.

3. The slight evidence of vertical displacements afforded by vertical spring seismographs.

4. Dr. F. Ōmori's observation that the amplitude of seismograms is not dependent upon the sensibilities of the seismographs to tilting suggests that the movements represented by large waves are horizontal rather than undulatory.

5. The smallness and paucity of records obtained from bifilar pendulums.

On the contrary, observations which support a surface undulation hypothesis are the following:—

1. Surface undulations exist in epifocal districts, and these, by the movement of water in ponds and lakes, the movements of the bubbles of spirit levels, the apparent movement of stars in the fields of telescopes, and by other phenomena, have been detected in districts many hundreds of miles beyond the epifocal area.

2. The approximately constant velocity of propagation assigned to large waves (see Fig. 1). This implies propagation in a homogeneous layer beneath the crust, the angular movements of which would be equal over considerable areas—a supposition which is supported by observations at three British stations.

3. Observations made by the writer in Japan and in the Isle of Wight, which show that the magnitude of a seismogram is dependent upon its sensibility to tilting, a conclusion apparently contrary to that arrived at by Dr. Ōmori.

4. The indications of a vertical component of motion, which have been recorded. These, however, have been very slight.

When discussing the characters of macroseismic motions it must not be overlooked that these characters are simply those as shown in seismograms which, to a greater or smaller degree, have been influenced by the natural period of the recording instrument. If this instrument has a short period, the preliminary tremors may be represented as having a large amplitude, whilst the so-called large waves become small; that is to say, so far as amplitude is concerned, we arrive at results the opposite to those described. The most certain element respecting these movements is that relating to the speed at which they are propagated, but even this, in these early stages of investigation, is open to modification.

Fig. 1, which shows the time taken for three types of wave-motion to

travel from an origin to stations at different distances measured in degrees, enables arcual or other apparent average velocities to be calculated.

Inasmuch as velocity through our earth depends directly on the square root of the coefficient of elasticity and inversely with the square

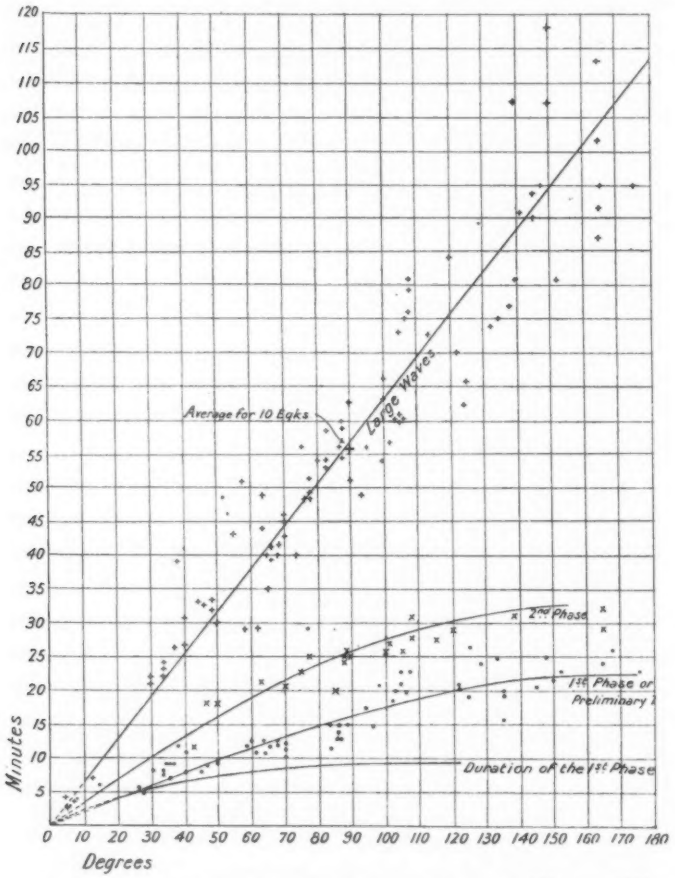


FIG. 1.—TIME CURVES FOR EARTHQUAKES RECORDED BETWEEN 1896 AND 1900 INCLUSIVE.

First phase or preliminary tremors · Second phase × Large waves +

root of its density, if we can make some assumption as to the distribution of density within our earth we are on the highway to make approximate determinations respecting its elasticity. Dr. C. G. Knott, of Edinburgh, has already occupied himself with this line of investigation (*Scottish Geographical Magazine*, January, 1899), and which, it is to

be hoped, now that better observational data are at hand, he will be induced to continue. As matters now stand, it appears that the effective rigidity of the world is nearly twice that of steel. It has a heterogeneous crust, and a nucleus more nearly homogeneous than is usually supposed.

Origins of World-shaking Earthquakes.

From Fig. 1 it will be observed that it is easy to measure the difference in time between the arrival of preliminary tremors and large waves at different distances from their origin. For example, preliminary tremors reach a place 80° from their origin in about 15 minutes, whilst large waves take about 50 minutes, the difference being 35 minutes. If, therefore, a seismogram shows such an interval, it means that it refers to an earthquake which originated somewhere about 80° distant. Having in this manner obtained the distances of an origin from several different stations, this origin may be easily located.

Another method of locating origins is from the difference in time at which the large waves arrived at widely separated stations. By these and other forms of calculations the origins of the world-shaking earthquakes for 1899, 1900 and 1901 have been determined. On the accompanying map an attempt has been made to place these earthquakes in groups, each group being enclosed by a dotted line. These groups are marked alphabetically and with numerals, the latter indicating the number of large earthquakes which took place in the district to which it refers. The pink bands give the direction of prominent ridges on the face of the globe, whilst the areas coloured blue are the "deeps" or depressions in the beds of various oceans exceeding 3000 fathoms in depth.

That there is a relationship between the distribution of the origins of large earthquakes and the pronounced irregularities on the surface of the earth will be seen from the following notes:—

A. *Alaskan Region* (number of earthquakes 25).—The average depth of the water in this bight is about 2000 fathoms, but in its northern part depths of 2200 fathoms have been found within sixty miles of the shore. On this shore Mount St. Elias rises to a height of 18,000 feet. An average slope from the land to the sea on a north-south line can be found which exceeds 100 feet per mile. This is over a distance of 180 miles.

On the face of this and neighbouring slopes during the last three years it is probable that molar displacements of great magnitude have taken place. On September 10, 1899, in the island of Kanak, opposite Yakuta, a graveyard sank so that on the next day a boat was able to row over the place where it had been, and the tops of the submerged trees could be seen. Many of the earthquakes from this region have yielded large seismograms at the Cape of Good Hope, which is antipodean to Alaska. We have here a district partly belonging to the

Alutian ridge, off the southern shores of which, within 80 miles of land, depths of 4000 fathoms have been noted, where orogenic processes are now marked, the extent of which will probably be gauged by future soundings.

B. *Cordillerean Region* (number of earthquakes 14).—This region forms the western side of the Mexican plateau and the Cordilleras. Just south of the 20° parallel a depth of 2800 fathoms has been found within 40 miles of the shore, whilst depths exceeding 2000 fathoms have been found a little over 100 miles from the land, somewhat farther to the south. Although there are peaks in these regions rising to heights close upon 18,000 feet, the average height of the ranges does not greatly exceed 6000. There are, therefore, in this region slopes of 180 to 570 feet per mile, and the instability of these is testified by the frequency of their yieldings.

C. *Antillean Region* (number of earthquakes 16).—Here we have at least two ridges to consider—that of Cuba, Haiti, and Puerto Rico running east and west, and that of Grenada, St. Vincent, Martinique, Dominica, and other islands running north and south. The east-west ridge slopes steeply to the north into water which, north of Puerto Rico, attains a depth of 4500 fathoms, and to the south into water 2500 fathoms in depth. These depths are respectively found at distances of 60 and 40 miles off land, and indicate slopes of 400 and 375 feet per mile. With the north-south ridge the slopes to the west over a short distance like 12 miles is 1000 feet per mile, whilst to the eastwards it is comparatively gentle. If these gradients be measured in lengths of 200 miles, the slopes are about 70 feet per mile.

D. *Andean District* (number of earthquakes 12).—At many points on the west coast of South America, within 50 miles of the shore, depths of from 2000 to 4000 fathoms occur, which correspond to gradients of from 250 to 480 feet per mile. Within a distance of 150 miles from the shore the land rises to a height of 12,000 feet, so that the gradients from them to the bottom of the neighbouring ocean may be taken at 120 to 180 feet per mile.

E. *Japan District* (number of earthquakes 29).—To the east of Northern Japan and the Kuriles, at a distance of about 180 miles off shore, depths of 4000 and even 4600 fathoms are found, indicating gradients of 130 to 150 feet per mile, and from observations made in Japan it is known that many of the large earthquakes originate on the face or at the bottom of these slopes.

F. *Javan District* (number of earthquakes 41).—Off the south-west coast of Sumatra and the south coast of Java, at distances of from 80 to 100 miles, depths of from 2000 to 3000 fathoms occur. The straits on the opposite shores of these islands are shallow, seldom exceeding 30 fathoms. Eastwards, from Java as far as Ceram, soundings between 1000 and 2000 fathoms are frequent. At one point 50 miles south of

the latter island there is a depth of 4000 fathoms. From this particular "deep" on September 29, 1899, a displacement took place the effects of which were partially visible by subsidences on the southern coast of Ceram. In this district the sub-oceanic irregularities are as irregularly distributed as the islands between which they occur.

G. *Mauritian District* (number of earthquakes 17).—The origins for this group of earthquakes are not well defined. They are probably related to the depression lying between the ridges represented by the Laccadives and Maldives on the east, and the Seychelles and Mascarine islands to the south-west.

H. *North-Eastern Atlantic* (number of earthquakes 22).

I. *North-Western Atlantic* (number of earthquakes 3).

J. *North Atlantic* (number of earthquakes 3).

The earthquakes originating in these districts have been few in number, comparatively small, and their origins are not well defined. Although a ridge is marked as extending up the Atlantic, it is comparatively small, and even in the vicinity of the Azores it is difficult to find a gradient over a distance of 180 miles which exceeds 33 feet per mile.

K. *Alpine, Balkan, Caucasian, Himalayan Districts* (number of earthquakes 14).—Strictly speaking this region, which is the only one from which earthquakes originate on a land surface, might be divided into four or more sub-regions according to the direction of the strike of the ridges which each represent.

The most pronounced foldings are in the eastern part of these districts, where, in distances of 100 miles, gradients of 120 feet per mile can be found; and it is from these steep slopes that the larger earthquakes have originated.

On the Magnitude of the Mass Displacements which accompany Large Earthquakes.

When a world-shaking earthquake takes place, and its origin is sub-oceanic, we occasionally get evidence that this has been accompanied by the bodily displacement of very large masses of material. For example, sea-waves may be created which will cause an ocean like the Pacific to pulsate for many hours. The dimension of the mass which was moved, and inasmuch as the displacement was beneath the surface of the ocean, must have been moved suddenly, to create an effect of this description, is not known. The observations made by cable engineers, which have shown that in the vicinity of the origin of such earthquakes depths have been greatly increased, and this over a considerable area, enable us to make rough approximations respecting these dimensions. When the effect has extended to shore-lines, we are enabled to measure definite amounts of elevation or depression.

With large earthquakes which have originated on land surfaces, the

accompanying displacements are visible, and their magnitudes are, to a certain extent, measurable.

The following notes, the first ten of which are taken from vol. ii. of Lyell's 'Principles of Geology,' 12th edition, will assist us in realizing the magnitude of the mass displacements which occur each time the world is shaken:—

1692. *Jamaica. The shore-line at Port Royal subsided* 26 *to* 48 *feet beneath the sea.* 1000 *acres sank.*

1755. *Lisbon. The quay sank.*

1762. 60 *miles of Chittagong coast sank.*

1783. *Calabria. The relative shifts along lines of rents were from* 6 *to* 10½ *feet. The quay at Messina sank* 14 *inches below sea-level.*

1790. *Caracas. Soil sank to form a lake* 800 *yards in diameter, and in places* 100 *feet in depth.*

1811-12. *West of New Madrid. The "sunk country,"* 70 *to* 80 *miles in length by* 30 *miles in breadth, was formed.*

1819. *Cutch.* 2000 *square miles of land were converted into an inland sea. At the same time land* 50 *miles long and* 16 *miles broad was raised about* 10 *feet.*

1822. *Chili. The shock extended* 1200 *miles. The coast was raised* 3 *to* 4 *feet, whilst a mile inland the rise was* 5 *to* 6 *feet. Possibly* 100,000 *square miles were permanently elevated, and if this was lifted* 3 *feet it means that* 57 *cubic miles of material had been suddenly shifted.*

1835. *Chili. An earthquake was felt along* 1000 *miles of coast, which was in places raised from* 2 *to* 10 *feet.*

1855. *New Zealand.* 4600 *square miles were raised* 1 *to* 9 *feet.*

1868. *Chili. Sea-waves reached Japan, where they rose and fell for five hours.*

1877. *Chili. Waves like those of* 1868 *disturbed the Pacific Ocean.*

1891. *Japan. River-beds were compressed about* 2% *of their width. A fault of* 40 *or more miles with a downthrow in places of* 20 *feet was formed.*

1892. *Sumatra. The length of base lines were changed* 5 *feet, and angles were altered.*

1897. *Assam. According to R. D. Oldham,* 10,000 *square miles of country were displaced, possibly* 16 *feet along a thrust-plane. A revisionary triangulation showed changes of* 4 *to* 24 *feet in the length of base lines, and in heights of* 2 *to* 14 *feet.*

1899, *Sept.* 10. *Alaska. A graveyard on the island of Kanak sank beneath the sea.*

1899. *Ceram. Subsidences along the southern coast.*

Earthquakes, accompanied by submarine displacements, along lines 10 and more miles in length and increased depths, such as have been recorded by cable engineers, also indicate molar displacements of great size. As examples of such changes the following may be quoted (see Suboceanic Changes, *Geographical Journal*, Aug. and Sept. 1897):—

1884, *Oct.* 4. *Three Atlantic cables* 10 *miles apart broke at apparently the same time at points opposite to each other.*

1893, *Sept.* 21. *Two cables between Pernambuco and Cape Verde broke simultaneously in a depth of* 1675 *fathoms.*

Between June, 1895, *and March*, 1896, *carefully made soundings off the mouth of the river Esmeralda* (*W. coast of South America*) *changed* 13 *to upwards of* 200 *fathoms.*

1896. *After the Filiatra shock depths increased* 200 *fathoms. Mr. W. G. Forster, in the Trans. Seis. Soc., vol. xv., gives many illustrations of such sub-oceanic subsidences.*

The cables connecting Java and Australia at places where they are 7 *miles apart have on several occasions been broken simultaneously.*

Large Earthquakes and Geomorphology.

If it can be admitted that world-shaking earthquakes involve molar displacements equal in magnitude to those referred to in the preceding list—which includes some which have been recorded as world-shaking—then, in the map showing the origins of these macroseismic efforts, we see the districts where hypogenic activities are producing geomorphological changes by leaps and bounds.

The sites of these changes are for the most part sub-oceanic troughs. When they occur, the rule appears to be that a sea becomes deeper, whilst a coast-line relatively to sea-level may be raised or lowered. For nearly all the regions of the world where they take place we have geological and not unfrequently historical evidence that the more recent bradyseismic movements have been those of elevation. This elevation, however, only refers to the rising of land above sea-level, while the mass displacements seem to be accompanied by sudden subsidences in troughs parallel to the ridges where rising has been observed. In short, at the time of a large earthquake, two phenomena are simultaneously in progress. A sub-oceanic trough may suddenly subside, whilst its bounding ridge may be suddenly increased in height, and the concertina-like closing of the trough may account for the sea-waves. If this be true for accelerations in secular movement, it seems likely that it may be true for changes relatively to sea-level which are performed slowly. In 1811 the sunk country of the Mississippi was formed suddenly, but since that time it appears that the synclinal then initiated has been slowly increasing in its depth.

Although there are movements of elevation and depression in progress in the crust of the earth, these should only be regarded as components of larger horizontal displacements which result in the accentuation in rock-foldings.

Large Earthquakes and Volcanic Activity.

Nearly all active volcanoes occur along the ridges of rock-folds

which are in proximity to oceanic waters. By the percolation of this water to the foundations of these folds, where it comes in contact with a heated magma, extraordinary pressures are developed, the sudden relief of which results in a volcanic outburst. If we accept a theory of this description it is easy to imagine a stage when volcanic strain due to an increasing internal pressure is in a critical condition, and therefore likely to be destroyed by any movement in the rock-fold where it exists.

A good illustration of this relationship between sudden movements in rock-folds and displays of volcanic activity is to be found in the history of the volcanic eruptions in the West Indies and the large earthquakes which have occurred in West Indies or in adjacent countries.

The conditions to be considered are those of the Caribbean sea and its bounding ridges, the magnitudes of which have been referred to on p. 8. The slopes of these ridges, per 30 geographical miles, are as follows:—

Antillean ridge	westwards, 1 in 17; eastwards, 1 in 38.
Jamaica—P. Rico ridge ...	northwards, 1 in 10; southwards, 1 in 20.
Cordillerian ridge ...	westwards, 1 in 15 to 1 in 33; eastwards, 1 in 15 to 1 in 38.
South American ridge ...	northwards, 1 in 30 to 1 in 150.

The average slopes (for 120 miles) in non-seismic regions vary between 1 in 90 and 1 in 243 (see 'Seismology,' p. 31), whilst those in seismic regions vary between 1 in 20 and 1 in 30. For the Himalayan-like boundaries of the Caribbean sea we therefore see that the geotectonic conditions are such that seismic disturbances might be expected.

From the recent geological history of the region we learn that the Antilles once connected North and South America, whilst the Isthmus of Panama was submerged, the present Caribbean sea being therefore a gulf of the Pacific. In Lower or Middle Miocene times, according to Dr. J. W. Gregory, Antillia itself was submerged, and abyssal oozes were deposited, which are now elevated in the Barbadoes to a height of 1095 feet above sea-level. In fact, the elevations and depressions of this region have been so great and performed with such rapidity that they have frequently been referred to by the opponents to the theory of the permanence of oceanic basins and continental masses. The most recent movements in the Antilles, as indicated by raised sea-beaches, etc., has been upward.

The inference to be drawn from the geological history of this region is that the Antillean ridge is one of unusual instability, and it is likely that in consequence of this characteristic it is so responsive, as will be shown to be the case, to adjustments in neighbouring folds.

The volcanic eruptions which have been recorded in the West Indies are, according to Fuchs ('Vulcane und Erdbeben'), eleven in number, and took place in the following years—1692, 1718, 1766, 1797, 1802, 1812 (two), 1836, 1851, 1902 (two).

The seismic convulsions which apparently resulted in these reliefs of volcanic strain were as follows:—

1692, *June* 7. *Port Royal in Jamaica destroyed, and houses thrown down throughout the island. St. Kitt's erupted.*

1718, *March* 6 *to* 7. *At St. Vincent's there was a very violent earthquake. Land rose from the sea, and then sank. Morne Garou (La Soufrière) erupted.*

1766, *March* 9. *Violent shock in Antigua. March* 17, *violent shock in Grenada. In Jamaica and Cuba seven shocks between June* 11 *and August* 1. *From the middle of July to the* 21*st violent shocks at Ste Marie, South America. August* 13, *Martinique shaken. August* 18, *Guadeloupe shaken. At the end of the month the city of St. Jago in Cuba was overturned. October* 6, *the island of St. Eustache was shaken. For fourteen months up to the end of* 1767 *Caracas was being shaken, at first almost hourly. October* 21, *Cumana was ruined. For two years the inhabitants of certain towns in New Grenada lived in the streets. An island in the Orinoco sank; Trinidad and Martinique were shaken. Qualibou, in St. Lucia, erupted.*

1797, *February* 4. *Destructive earthquake in Quito, and* 40,000 *persons lost their lives. A series of small shocks lasting eight months took place in the Lesser Antilles. These were "put an end to" by an eruption in Guadeloupe on September* 27.

1802, *February* 2. *"Severe shock" in Antigua. In February and March shocks in the West Indian Islands. In Guadeloupe there were shocks, and in February an eruption.*

1812. *On March* 26 *Caracas was destroyed, and* 10,000 *people lost their lives. Shocks continued until April* 5. *The waters of Lake Maracaybo lowered, and Mount Silla is said to have subsided* 360 *to* 300 *feet. In St. Vincent more than* 200 *shocks were felt, and on April* 24 *La Soufrière erupted, and its ashes fell in Barbados.*

On November 11, 1811, *a tremendous earth disturbance commenced in the valley of the Mississipi, Ohio, and Kansas, resulting in the formation of the sunk country. The shocks continued almost hourly until the date of the destruction of Caracas. Guadeloupe also erupted in* 1812.

1835. *On February* 20*th an earthquake was felt for* 1000 *miles along the coast of Chili. Towns were destroyed, and the coast was raised from* 1 *to* 10 *feet. A submarine volcano broke out off Bacalao head, and the volcanoes in the Andes were in an unusual state of activity. In November Concepcion was severely shaken, and on the same day the volcano Osorno,* 400 *miles distant, renewed its activity. Lyell points to these events as illustrating the vast extent of the subterranean areas over which a disturbing cause acts simultaneously.*

In 1831, *on June* 22 (*or May* 22, 23), *different places in Central America*

were shaken, and a volcano east of Omoa erupted. There was also an eruption in Guadeloupe.

1851, *April* 2. *Great earthquake in Chili, followed by heavy rain. Santiago, Valparaiso, and other cities suffered. Eruption of Mount Pelée.*

1902, *April* 19. 8.25 *p.m. (local time), disastrous shock. Western Guatemala and the richest city in the country, Quezaltenango, were completely destroyed. About* 1000 *lives were lost. The intensity of the vibrations was such that they spread over the whole of the world, and it may be inferred that this commenced an adjustment in Cordillerian fold. The effect of this adjustment apparently spread to the Antillean fold, and about the date (certainly on April* 25) *Mount Pelée showed a plume of vapour, and small earthquakes were felt in Martinique and St. Vincent. From this time the symptoms of volcanic and seismic activities became more and more pronounced, until May* 7 *and* 8, *when they culminated with submarine disturbances and terrible explosions in Martinique and St. Vincent.*

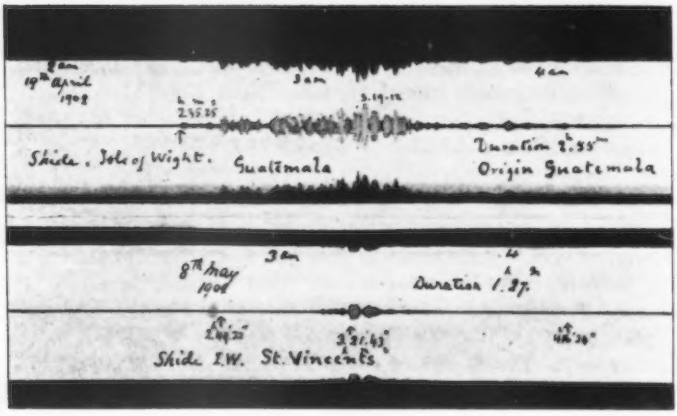


FIG. 2.—RECORD OF EARTHQUAKE WHICH LED TO THE WEST INDIAN ERUPTIONS, AND RECORD OF EARTHQUAKE WHICH OCCURRED DURING THE ERUPTIONS.

From the fact that the vents in these two islands, which are separated from each other by a distance of 87 miles, practically commenced their various eruptions at about the same time, the inference is that they are both affected by a general movement of the Antillean ridge. Something similar to this took place in 1883, when, by the eruption of Tarawara, New Zealand lost its Pink and White terraces. Four or five days later White island in the Bay of Plenty became active, and two months later there was an eruption, 1200 miles to the north, in the Togan group, which islands, with the Kermadecs and New Zealand, forming, according to Dana, one of the feature-lines of

the earth's crust (see *Am. Jour. of Sci.*, March, 1889, "On the Origin of Deep Troughs of the Oceanic Depression," by T. D. Dana).

From the following table, which is chiefly compiled from the writings of Rockstroh and Fuchs, it will be noticed that *all* the West Indian eruptions have been accompanied by unusual seismic disturbances either in the West Indies themselves or in neighbouring rock folds:—

DATES OF VOLCANIC ERUPTIONS IN CENTRAL AMERICA AND THE WEST INDIES.

1552 ...	1699 ...	1785— ...	1852—
1526— ...	1705— ...	1797×— ...	1853—
1541 ...	1706 ...	1798— ...	1854—
1565— ...	1707 ...	1799— ...	1855—
1581 ...	1709— ...	1802×— ...	1855—
1582— ...	1710 ...	1803— ...	1856—
1585-6— ...	1717— ...	1809— ...	1857—
1614 ...	1718×— ...	1812×— ...	1858—
1623 ...	1723 ...	1821— ...	1860
1643 ...	1726 ...	1828 ...	1865
1651— ...	1732— ...	1829— ...	1867—
1664 ...	1737— ...	1833 ...	1868
1668— ...	1764 ...	1835— ...	1869—
1670 ...	1766×— ...	1836×— ...	1870
1671 ...	1770 ...	1844— ..	1873
1677— ...	1772 ...	1847— ...	1880—
1686 ...	1775 ...	1850 ...	1883
1692×— ...	1775 ...	1851×— ...	1902×—

West Indian eruptions are marked ×.
Unusual seismic disturbances are marked —.

One inference to be drawn from the above notes is, that if dormant volcanoes in a state of volcanic strain may be brought into activity by a mass-displacement of the fold from which they rise, small earthquakes, of which we will show that at least 30,000 occur yearly, do not give rise to such disturbances. Mount Fuji in Japan has now been dormant for the last 195 years, during which time it has been subjected possibly some 15,000 times to such shiverings, and yet it is quiescent. There may be many hundreds of similar mountains in this world, whose internal pressures are in all probability gradually increasing. Should a stage be reached when this is barely balanced by the restraining influence of an external cover, it is easy to imagine that some macroseismic effort may destroy the equilibrium, and eruptions follow.

Macroseisms and Magnetics.

With the object of learning whether any relationship existed between world-shaking earthquakes and unusual movements of magnetic needles, in 1897 I sent a list of large earth-movements which had known origins to 32 different magnetic observatories, asking that the same might be compared with their magnetograms. Detailed replies received from 13 of these observatories are published in the *British Association Reports* for 1898 and 1899, to which general remarks about

observations at other stations are added. The inferences to be derived from these replies are as follows:—

1. At Greenwich, Kew, Falmouth, Stonyhurst, Pola, Vienna, Copenhagen, and Toronto, the magnetic needles are seldom, and then only very slightly, disturbed at the time of large earthquakes. For the Toronto instruments this statement, however, is only true for the time they were installed in Toronto. Since they were removed to Agincourt, which I believe is about 10 miles from Toronto, the same instruments have frequently been disturbed at the time of earth-movements.

2. At Utrecht, Potsdam, Wilhelmshaven, Bombay, to some extent at Batavia, and now at Toronto, the magnetic needles so frequently respond to the unfelt waves of large earthquakes that their records have been of value to the seismologists.

3. At Zikawei, Mauritius, Utrecht, Greenwich, and Japan, perturbations of considerable magnitude have been observed a short time before the occurrence of large earthquakes.

One explanation which may be offered for this marked difference in the behaviour of magnetic needles at different stations is to assume that there is a considerable difference in the mechanical movements experienced at different stations, dependent, perhaps, upon the differences of their foundation and the differences in distance from the origin of a given disturbance. When, however, we note the difference in behaviour of instruments at Toronto and Agincourt, or at Copenhagen and Wilhelmshaven, which are practically at the same distance from the origin of many large earthquakes, the latter explanation fails. Again, if we consider foundations, we find that perturbations occur at Wilhelmshaven but not at Copenhagen, which are both situated on the plain of alluvial drift which stretches from Holland eastwards into Russia. Another suggestion is that the periodic motion of needles at certain stations may synchronize with the period of the earth-waves. What we, however, find is that, although the unifilar periods at Potsdam and Kew are practically identical, at the former station perturbances are common, whilst at the latter they are practically unknown. Also it must not be overlooked that, although the periods of "unifilars" at the stations considered usually vary between 5 and 14 seconds, whilst the "bifilars" vary between 5 and 18 seconds, almost all large earthquakes yield groups of waves which will coincide with any of these periods, and therefore if earth-waves cause magnetic needles at one station to rotate through arcs of from 1 to 7 minutes, showing on the photographic film displacements of 2 to 15 millimetres, similar perturbations might be expected to occur at all other stations.

The maximum tilting to which magnetometers are subjected when they indicate the above movements as a maximum, may be taken at 10 seconds of arc. This means that a needle with a 12-inch suspension has its point of support moved about the one-hundredth of a millimetre,

and this with a period of from 10 to 20 seconds. Whether this minute and exceedingly gentle disturbance is sufficient to set up the *rotations* observed is a matter which might be answered by experiment.

From the above remarks, it therefore appears premature to conclude that the movements under consideration are due to mechanical causes. The next suggestion is that the cause is magnetic. Inasmuch as large waves are propagated over long distances with a constant velocity, and cause a heterogeneous crust over a considerable area to move uniformly, it may be assumed that such waves are propagated in a uniform medium, which lies beneath the crust of the Earth. With such conditions, it is most likely that magnetic disturbances will be most marked at those stations which are nearest to the moving *magnetic* mass, the differences in distance between a given set of stations and this magma being the difference in thickness of the intervening crust at these various stations. The reason for qualifying this magma as magnetic rests on the fact that most volcanic materials which reach the surface of our Earth are magnetic in character, and the disturbing influence which certain volcanic eruptions have apparently had upon magnetic elements, has frequently been recognized (see 'Seismology,' p. 223, Int. Sci. Series).

If such an explanation as this is true, then in the vicinity of the stations where earth-waves produce marked disturbances of magnetic needles we should expect to find evidence of the existence of a hidden chain or mass of unusually dense material. In other words, the value of g as observed at these stations should be greater than at those stations where magnetic needles are not disturbed—*cæteris paribus*.

With the object of determining whether it is worth while making a close investigation of this suggestion, Dr. Charles Chree, F.R.S., very kindly furnished me with a list of observed and calculated values for g abstracted from the work of the Austrian Marine (*Veröff. des Hyd. Amtes der k.u.k. Kriegs Marine in Pola*, No. 14, Pola, 1902). From them I make the following selections as referring to stations where there are magnetometers; g is expressed in metres per second; Helmert's formula $\gamma = 9{\cdot}780(1 + 0{\cdot}00531 \sin^2 \phi)$ is used for theoretical values, and Oppolzer's determination, $g = 9{\cdot}80876$ at Vienna, for standard value:—

Place.	Latitude.	Observed and reduced to sea level, etc., g.	Calculated γ.	$g - \gamma$.
	° ′ ″			
Pola	44 51 48	9·80648	9·80584	+ 64
Melbourne, 1893 ...	37 49 54	9·80013	9·79954	+ 59
„ 1894 ...	„	9·80019	„	+ 65
Bombay	18 53 48	9·78655	9·78545	+ 110
„	18 55 23	9·78663	9·78546	+ 117
Batavia, 1893 ...	6 5 48	9·78193	9·78059	+ 134
„ 1894 ...	6 11 0	9·78195	9·78060	+ 135

For the two latter stations where magnetic needles are disturbed, it would appear that the value of $g - \gamma$ is about double that which it has for the two former stations where marked disturbances have not been observed.

At several other magnetic stations like Greenwich, Kew, Zikawei, where magnetic needles are practically undisturbed at the time of large earth-waves, the values for $g - \gamma$ are of the same order as those given for Pola and Melbourne. Add to this the fact that the pendulum has revealed the existence of a chain of dense material crossing India to the north of Bombay, and the suggestion that seismometrical and gravitational investigations may possibly have a relationship is at least deserving some consideration. If an earthquake is preceded by chemical, physical, or mechanical changes in such a magma, this might throw light upon the observations at Zikawei, Mauritius, Utrecht, Greenwich, and in Japan. A second inference is that if needles at Utrecht, Potsdam, Wilhelmshaven, Bombay, and Batavia are disturbed by changes in a magnetic magma in their vicinity, Dr. J. E. Murray points out that at those stations magnetic intensity might be abnormal. This, however, is only true for the two latter stations.

Large Earthquakes and Small Changes in Latitude.

In the 'British Association Report for 1900,' p. 107, there is a table which, for the years 1895 to 1898, shows the number of large earthquakes which took place every successive 36·5 days. Opposite to each of these entries the pole-displacements are recorded. Those which are measured from a figure given by Prof. Th. Albrecht, of Potsdam, represent one of the results obtained by the International Association of Observatories now engaged in the determination of variations in latitude. The figure, somewhat extended by previous observations, is to be found in 'Die Veränderlichkeit des Geographischen Breiten,' a paper by Dr. Albrecht, published by the International Geographical Congress held in Berlin in 1899.

What the table shows is that when the pole-displacements have been relatively large, world-shaking earthquakes have been numerous, and *vice versâ*.

In the yearly totals this is marked. Thus—

In 1895 there were	9	large earthquakes and a	*total*	displacement of	0″·53
„ 1896	„ 18	„	„	„	0″·91
„ 1897	„ 44 or 47	„	„	„	1′·07
„ 1898	„ 30	„	„	„	0″·79

It is not supposed that the molar displacement these earthquakes represent were sufficient to cause the polar change, but, as pointed out by Prof. H. H. Turner, it seems possible that both may result from a common cause. Until further comparisons have been made, it is, however, somewhat early to formulate hypotheses.

II. Microseisms, or Small Earthquakes.

The number of shocks recorded annually.

Mallet, in his Report to the British Association, 1858, p. 51, says that between A.D. 1001 and A.D. 1850 the average number of earthquakes noted per year in the world was 7·7. Between A.D. 1551 and A.D. 1850 it was 17·3, whilst between A.D. 1701 and A.D. 1850 it was 35·3. The conclusion drawn from these and similar figures is not that seismic activity is increasing in the world, but that observation has become more general. From Fuchs' 'Statistik der Erdbeben' we learn that between 1865 and 1884 the number of earthquakes recorded in the Northern Hemisphere only was 8133, which represents an average per year of 428. If we turn to still more recent catalogues, as, for example, those brought together by F. de Montessus de Ballore, we find the annual frequency for the world given as 3830. Although this number is large, its author regards it as being far below actuality. For many countries in the world earthquake records are not kept, and in those where they are kept, with but few exceptions, the registers are far from perfect. Then, again, all our catalogues refer to shocks which have been felt upon the land, whilst those which have had suboceanic origins and never reached the land necessarily remain uncounted.

In order to form some idea of the average number of shocks which take place annually, all that we can therefore do is to make estimates based on various hypotheses.

1. As the result of an elaborate seismic survey yet in progress in Japan, we know that in this country, and chiefly along its seaboard, about 1000 shocks are recorded every year. We also know that the number of world-shaking earthquakes which originated on the flanks of the Japan fold in 1899, 1900, and 1901 was 29 (see map, p. 108).

During that same period in the world there were at least 168 disturbances, approximating in magnitude to those originating in the Japan districts. Now, if the number of small shocks recorded in a country is proportional to the number of larger shocks, then the total number of shocks which occur annually would, for the districts considered, be about 6000 for world-shaking earthquakes originating on land. We have, however, learned that the number of after-shocks recorded at a given station depends upon the distance of that place from the origin of the original disturbance. After the great earthquake of 1891, the after-shocks recorded at distances of 17, 36, and 60 miles from its origin were, as pointed out by Dr. Ōmri, 4500, 2000, and 140 to 350. Bearing in mind the fact that the majority of the Japanese records refer to disturbances originating many miles off its coast, it is reasonable to suppose that very many earthquakes occur which fail to reach its shores. Were it possible to record these, it seems certain that the frequency for

the Japan district, and consequently the frequency for the world, would be increased several fold.

2. If it is assumed that the number of earthquakes which occur in any larger section of the globe, like a continent, is proportional to its area, and if we know the average number recorded in one of these sections, we have evidently the means of estimating the number of earthquakes which may be expected to occur in other sections of the world. In the following table we have the average earthquake frequency for the continents as given by Ballore, the ratios of their areas, Europe being taken as the unit, and the expected numbers of earthquakes on the assumption that the yearly frequency for Europe is 2000—this latter continent being selected as the basis for calculation because its seismicity is best known:—

	Observed average frequency.	Ratio of areas.	Expected frequency.
Europe	2027	1	2000
Asia and Japan	733	5	10,000
Africa	69	3	6000
North America	561	2	4000
South America	164	1·8	3600
Oceania	269	1	2000
Total	3823	—	27,600

3. Inasmuch as the ratios of the areas of seismic activity to those of the aseismic districts may be very different, a closer estimate may be obtained if seismic districts are taken by themselves. As a unit district we may take Greece, Turkey, Austria, Italy, Switzerland, South Germany, and South France. In this district, M. Ballore's figures indicate that the annual frequency is 1900. On a globe 50 centimetres in diameter, this area is equivalent to that covered by a strip of paper 16 × 2 centimetres. With this last area as unity, the ratios of the seismic areas in other parts of the globe and the number of earthquakes which may annually occur in the same are as follows:—

	Ratio of areas.	Frequency.
Central Europe	1	1900
Asia and Japan	3·5	6650
South of Japan to Java, and Sumatra to New Guinea	2·5	4750
North of Japan and East to Alaska ...	1	1900
North and South America	4	7600
Africa	0·5	950
West Indies, New Zealand, and other parts of the world	1·0?	1900
	—	25,650

Nearly all large earthquakes are followed by a long series of "after-shocks." These, which are most frequent in the epifocal area, are regarded as sudden settlements and adjustments on the fault plane or planes created at the time of the primary disturbance. After the disturbance of October 28, 1891, which had its origin in Central Japan, and which may be regarded as a typical world-shaking earthquake, during the first twelve months 2956 shocks were noted. In the year following this number had decreased to 391. If we assume that each of the 50 large earthquakes which annually disturb the world give rise to 500 shocks during the following year, whilst the 50 primary disturbances of the preceding year are represented by 50 after-shocks, then, without considering the after-shocks of still earlier years, the conclusion arrived at is that in any given year there are at least 27,500 which could be recorded in epifocal districts.

Although the above estimates result in large numbers, it seems likely that on the average every year 30,000 earthquakes take place, each of which disturb 10 up to several hundreds of square miles of the Earth's surface, and would be sufficiently intense to be felt by many people.

Relation of Microseisms to Earth Structure.

As stated in the introduction to this paper, microseisms may for the most part be regarded as settlements along lines of fissures and amongst disjointed materials, the first formation of which was in all probability macroseismic in character. Some, no doubt, are initial stages in primary fissuring, but the majority, when traced to their birthplace, find an explanation in some slight shift on the line of an existing fault. For Great Britain Dr. Charles Davison has done most excellent work in tracing local earthquakes to this latter cause. The Comrie earthquake of July 12, 1895, like many which preceded it, Davison shows came from the highland border fault, and as the disturbed area is chiefly on the north-west side of this fault, the probability is that it hades in this direction. In other instances he has shown that a fault has been extended in its length, whilst at other times the existence of a fault has only been inferred. Not only has this work extended our knowledge of the cause of certain earthquakes, but it has also increased our knowledge of the changes which are taking place in structural geology. Of these changes there are about thirty thousand per year. Individually they seldom produce any effect visible on the surface of the Earth, but each represents some small subterranean movement about the cumulative effects of which we can only speculate.

III. Utility of Seismograms.

From seismograms obtained in epifocal areas, measures of earth quake energy expressed in mechanical units have been obtained. One result of this has been that engineers and builders in earthquake-

shaken countries now build to withstand known forces. In Japan it has been repeatedly shown that bridges and buildings constructed according to European practices are unable to withstand the severe shakings which so frequently occur in that country, and therefore, as opportunity presents itself, the old types of structure are being replaced by forms which experience has proved are not so readily disturbed. The importance of seismology is so far recognized by the Japanese Government that at its University we find a professor and assistant professor of this subject, whose duties in part consist in giving to students of engineering and architecture a course of instruction bearing upon their future profession.

The Government also support a bureau, controlling about one thousand stations, and in addition to this they grant an annual subsidy to a committee consisting largely of practical men, whose duty consists in making investigations which will lead to the mitigation of earthquake effects. Not only does this body investigate destruction which from time to time occurs in Japan, but should a disaster take place in Manila, India, or some distant country, a commission is despatched to report upon that which fell and that which remained intact. By this means Japan has become a repository for almost all that is known about applied seismology, which already has been the means of saving life and property. Seismograms of unfelt earthquakes not only explain certain irregularities in magnetograms, but they also throw light upon abnormal movements in the records from electrometers and barometers. Apparent changes in the rates of timekeepers have frequently been traced to earth-movements, the occurrence of which would not be suspected without the aid of seismograms.

It has often happened that cables have been destroyed by submarine earthquakes, and to know the cause of such interruptions is of great importance, especially to communities who have, by such occurrences, been suddenly isolated from the outer world. The breaking of cables has been regarded as an operation of war, with the result that military and naval preparations were made, expenses of various descriptions were incurred, and naturally there was much alarm, all of which would have been avoided by the inspection of a seismogram (see "Sub-oceanic Changes," *Geographical Journal*, August and September, 1897).

Seismograms, we have shown, enable us to locate submarine sites where it would be rash to lay a cable. Lastly, they enable us to confirm, correct, extend, and occasionally to disprove messages that come by cable describing seismic catastrophes in distant countries.

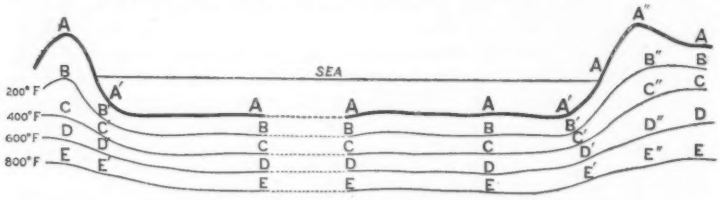
After the reading of the paper, the following discussion took place:—

Dr. BLANFORD: I have listened with very great pleasure to the address of Prof. Milne, and I am not competent, even were I disposed, to criticize his observations. In this inquiry Prof. Milne is endeavouring to solve what has always

been a great problem for geologists—the origin of the movements that affect the crust of the Earth, and the effect of those movements upon the forms that are assumed by the surface of the Earth both on the land and under the sea. And, to a certain extent, there is no doubt that he and others who have studied the subject have succeeded. We who have spent a great part of our lives in the study of geology, are acquainted with numerous dislocations of the Earth's crust; they are of very frequent occurrence, and are known by a term—faults—originally employed by miners. Now, I think one of the most important facts that have been demonstrated is that when these fractures in the rocks near the surface of the Earth are formed, they are attended by earthquakes. The original cause of the fractures is in need of further elucidation. Prof. Milne has explained that there are large and small earthquakes, and some of the largest earthquakes seem to have been accompanied by similar movements to the small seismic disturbances. There has been a general acceptance of the view that surface changes, such as elevation, depression, and dislocation, the formation of mountain ranges, and the disturbance of the rocks forming the Earth's crust, are due to the shrinking of the Earth's interior, in consequence of loss of heat, and to the consequent pressure on the crust, which, having already cooled, cannot shrink with the interior. The loss of heat is in all probability one of the causes of the lateral pressure which results in disturbed and fractured strata, but it is very doubtful whether it is the whole explanation, some local cases of compression appearing too great to be explained by subterranean loss of heat alone. Changes in latitude to which Prof. Milne has called attention may be cumulative, and may in past times have been of considerable amount. Another curious and interesting question to which Prof. Milne briefly alluded is the effect of magnetism. I can only say, before sitting down, that I think we are all very deeply indebted to Prof. Milne for giving us a lucid account of a rather obscure subject.

Prof. PERRY: I have been called upon to speak, probably because I have had a sort of connection with Prof. Milne for a good many years; he has harnessed me and many other people to the waggon he is drawing; in spite of my ignorance, he compels me to act as a member of the British Association Committee on Seismology. I have not recently thought much about the subject, but when hearing this fine address, I have again been struck with the extraordinarily great velocities with which earthquake motion is transmitted through the inner earth. It is difficult to understand, but these records show that the stuff inside the Earth is a great many times more rigid than the hardest steel. We do not know what the materials are; probably there is much iron; probably much gold and platinum near the centre. It is exceedingly hot; it is under such enormous pressures that our laboratory experience is of no use to us in speculating about the properties of the stuff. But we see that the stuff is very rigid. This agrees with what we know from Lord Kelvin. He has shown from tide phenomena that not merely for these quick motions of periods like one second, but for quite slow changes in distortional force, of periods like a day or a fortnight, the Earth is at least as rigid as if it were steel. Here is a stubborn fact, not difficult to understand, if we think of how a liquid Earth must have cooled to its present solid state. But with this fact before us, it is very difficult to understand why, when there are earthquakes and volcanic eruptions in one part of the Earth, they are soon followed by earthquakes and volcanic eruptions at other and distant places. There seems to be some communication between different parts of the Earth, such as there would be if the Earth were liquid inside, and we know that the Earth is not liquid inside. When lava flows from a volcano, we know that it was probably kept in a solid state by great pressure, and that its liquefaction is due to the relief of the pressure. Now, as

I listened to this paper, it came to me to think that, although the Earth is very rigid, like pitch or sealing-wax when subjected to forces of such periods as Prof. Milne and Lord Kelvin deal with, it may not be at all rigid; it may yield and flow and transmit forces like a fluid when the forces alter more gradually. At the bottom of a deep mine, even granite and other hard rocks flow under great pressures, and we know that the hardest steel can be made to flow, so there is nothing very extraordinary in our assumption that the stuff inside the Earth, under conditions of temperature and pressure such as we have no conception of, may also yield and act almost like a fluid when it has time enough. In the figure, if S is the surface of the sea, A the land's surface, the surface B shows where the rock is all at 200° Fahr., being about 2 miles deep generally, underneath the sea. The surfaces C, D, E are at 400° Fahr., 600° Fahr., 800° Fahr. As there is very much more surface area at A″, the isothermals are there further apart; as there is less surface area at A′, the isothermals are nearer.



I take it that we have as main causes of change—(1) The Earth on the whole is contracting underneath. As it contracts, the surface skin falls in, and as it resists contraction, it is in compression, and so there is a tendency to lift A″, to depress A′, and there is great tendency to fracture along the thin layers A′B′C′D′E′. This is the main cause of earthquakes at A′. (2) The great weight of the mountains, A″, causes a tendency for lateral flow towards the sea-bottom, A′, the sort of flow noticed in deep mines; this is a constant tendency to produce fracture at A′. (3) When A″ is further raised and A′ sunk, there is a diminution of pressure at E″ and an increase at E′. The percolation of water and generation of steam will tend to equalize the pressures at E″ and E′, consequently mere gravitation will act and tend to lower E″. Percolation of water through miles of rock being a slow process, the tendency of the hills to rise and afterwards sink will alter very gradually.

Below a certain depth we can imagine the stuff, under enormous pressure and temperature, to be capable of transmitting pressure like a fluid if sufficient time is allowed. Hence an elevation or a depression of a region in mid-ocean, where the surface rock is more yielding than elsewhere, may cause diminution or increase of the existing pressure at places underneath A′, A′, more or less nearly simultaneously.

Captain CREAK: I do not know that I can say very much on this question, but, at any rate, I may congratulate Prof. Milne on having given us a very interesting paper. I think that both magneticians and those who study seismology will eventually have much in common, for I consider that, on the whole, Prof. Milne has established one point—that the disturbance of magnets he has noticed was not caused mechanically by the shaking of the Earth or by tilting; he has fairly established that. We know perfectly well that iron and steel, when subject to stress or vibration, are liable to change of their magnetic condition, and we may also infer from this that magnetic rocks that have no motion of translation, when subject to stress are also subject to change of magnetism; it is stress which causes

the change in the magnetism of the Earth, and consequent disturbance of the magnetic needle. I have been to Shide, and have seen Prof. Milne's apparatus there, and I was particularly struck with the delicacy of those instruments. He made fast a thread to the top of a lamp-post such as we have in the street, that lamp-post being embedded firmly in the chalk. The smallest pull on that thread was most beautifully marked upon his apparatus. You could tell the slightest motion. Now, I do not think any of our magnetometers would be shaken in that way, so I am rather inclined to think he is right in saying it is not tilting, and I hark back upon the compression as being the cause of the needle disturbance. Then the lecturer spoke of the differences between different observatories. I think he is perfectly right in saying it is the density of the mass below some observatories which causes the magnetic change when it is subject to compression. In others there is no magnetic mass to compress. If we go to Edinburgh, I can imagine the volcanic rocks being exceedingly compressed during an earthquake. That is a direction in which we should make further inquiry, and I think Prof. Milne has been so far wise in calling this question of magnetism to his aid, and I hope he will continue to work with magneticians.

The PRESIDENT: I think the meeting has listened with very great interest to the splendid paper which has been communicated to us by Prof. Milne. In the name of the Council I must congratulate him, in the first place, on his apparently great success in establishing or getting established, in various parts of the world, the observatories which are so necessary for the advancement of his investigations. We should have been glad to have furthered his views, and I myself did make some efforts to assist him some years ago in that way. I see that we have three or four observatories in North America, and two in South America, which are registering the phenomena of earthquakes. I have no doubt, therefore, that Prof. Milne will be able to collect all the existing records on the subject. Some years ago now, I remember making a list of earthquakes on the west coast of South America, going back three centuries, and since that time I note that a much fuller and more elaborate list has been made of the same phenomena along the west coast. I have no doubt similar records may exist in other parts of the world. It only remains for us now to accord a unanimous vote of thanks to Prof. Milne for his most valuable and interesting paper.

NOTES ON THE COUNTRY BETWEEN LAKE NYASA AND VICTORIA NYANZA.*

By OTTO L. BERINGER, Assoc. M. Inst. C.E., F.R.G.S.

THE surveys on which the accompanying route-map is based were carried out between the years 1897 and 1901. No astronomical observations were made, the positions of Karonga and Abercorn being taken from the observations of the Anglo-German boundary commissioners, and Kisumu from the Uganda railway survey.

The work was done throughout for the African Trans-continental Telegraph Company, the author being their chief surveyor. As far north as Ujiji preliminary surveys were made by plane-table, and these were subsequently corrected from the survey of the telegraph line,

* Map, p. 108.

carried out with a 5-inch theodolite and chain. Between Ujiji and Kisumu the map cannot be classed as other than a route-sketch, a prismatic compass, watch, and aneroid barometer being the only instruments used.*

Much has already been written, both as to the physical aspect and the native inhabitants of the country between Usisia and Kituta at the south end of Lake Tanganyika. Particularly striking is the rocky and mountainous nature of the coast north and south of Usisia, terminating in the former direction at the well-known precipitous landmark, Mount Waller, whence, as a reference to the map will show, the mountain range trends inland, so that if we start from Karonga, along the Stevenson road, we meet with it again at Mount Viraule. Apart from

WEST LAKE NYASA, NKATA BAY.

isolated ranges of hills, the intervening land is very flat, and shows at different elevations three and four different old coast-lines, which prove

* Mr. Beringer plotted his plane-table survey, Usisia to Ujiji, on the scale of 1 : 250,000, and his prismatic-compass survey, Ujiji to Kisumu, near Port Florence, on the scale of 1 : 500,000. The prismatic-compass survey was enlarged to the scale of the plane-table survey and laid down on a sinusoidal projection, fixing one end at Kisumu. The plane-table survey was also laid down on the projection with one end fixed at Abercorn; the other met at Ujiji, and the point of meeting fell within some 3 minutes of longitude of the position observed by Mr. Fergusson and Dr. Kohlschütter. As this position (29° 40′ 12″) is about 20 minutes westward of the hitherto accepted position, the coincidence is not only remarkable, but supports the accuracy of the very arduous piece of work successfully accomplished by Mr. Beringer.

the lake to have at one time approached, or even actually washed, the base of this range, leaving the hills, such as those directly north of Deep bay, as islands. Whether the present conditions are owing to the upheaval of this part of the lake or its secular drying up must be left to the theories of others; certain, however, it is that the forces concerned reach their maximum of activity at long but well-defined intervals. The sharp and rocky pinnacles bordering the Nyika plateau as seen from Karonga are indeed magnificent, many of the towering and needle-like points being quite inaccessible.

The Tanganyika plateau traversed by the Stevenson road reaches its highest points at Mambwe and at Fwambo pass near Abercorn, the

CORNFIELDS, LIVINGSTONIA MISSION, NEAR MOUNT WALLER.

former being on the watershed between the Saisi river draining into Lake Rukwa, and the Chambezi draining *viâ* Lakes Bangweulu and Mweru into the Congo; the latter on that between the Saisi and Tanganyika. Hills and mountains rising right and left of the Stevenson road make the scenery at places and at certain times of the year very beautiful. A peculiar sensation is felt by those unused to the climbing of plateau slopes in ascending from Karonga: what look like mountain peaks are, when passed, no longer visible, and this occurs from step to step, as it were, for some 40 miles, until the higher slopes of the plateau proper are surmounted, and the hills and mountains, quite to one's satisfaction, are found to be genuine all round. The road has to a great extent been reconstructed, and waggons can run freely

from Fort Hill to Tanganyika. The chief stations in this part of the territory may be here enumerated. On Deep bay, Lake Nyasa, there is a station of the British Central Africa Administration, usually filled by one European only. The following occur along the Tanganyika plateau road: *Karonga*, where is stationed a collector of the B.C.A.A., contains several stores, an operating station of the African Trans-continental Telegraph Company, and a branch of the Livingstonia Mission, the headquarters of which are at Kondowe, behind Mount Waller. *Fort Hill* is a sub-collecting station of the B.C.A.A., with usually one European resident. Then, as we cross the Nyala stream into North-Eastern Rhodesia, we reach *Nyala*, a sub-collecting station; but, owing to its seemingly unhealthy situation, no European resides there. *Fife*, where a small township has been laid out, is inhabited by several officers of North-Eastern Rhodesia Administration, an operator of the A.T.T.C., and several storekeepers and traders. A few miles further on, and on the left of the road, is a station of the London Missionary Society; and then shortly a very substantial station belonging to the African Lakes Trading Corporation, usually the quarters of three Europeans. *Mambwe*, formerly a mission station of French Catholics, was made into a sub-collecting station of the N.E.R.A., then sold, and has now no fixed resident, but is much used as a resting-place; it is situated over 5000 feet above sea-level, and during the months of June, July, and August is very bleak.

Kawimbi, another station of the London Missionary Society, is next met with. It contains a church, school, shops, and houses for the three or four Europeans stationed there. Gardening and carpentry are taught, and the excellent results in both departments are very much appreciated by the residents at Abercorn and elsewhere; nor should the hospitality and medical care ungrudgingly given by its inmates to the numerous Europeans continually calling, be passed over without commendation. *Abercorn*, another township, situated some 14 miles from the south end of Lake Tanganyika, comes next. It is a large and important station, the quarters of a collector, assistant-collector, and other officers of the N.E.R.A., and has a telegraph office of the A.T.T.C., besides stores and offices of several trading companies. Near by is Lake Chiuta, a small and picturesque sheet of water, the haunt of many ducks and geese and other wildfowl. Eight miles further on the road commences to descend, and *Kituta*, on Lake Tanganyika, is reached, or, by branching to the left, the new station of *Kasakalawe*, also on the lake. Between Kituta and the lake proper a mile of low flat country intervenes, sandy and difficult to walk on in the dry season, and a quagmire in the wet. Kasakalawe, on the other hand, has the advantage of a dry and well-timbered shore, with deep water a few feet off it affording a satisfactory shelter, and is altogether a far superior place to the older Kituta. At both these stations Europeans reside.

The Tanganyika plateau is well timbered, though the trees are not usually of large circumference. In places, such as the ravines of some of the mountains and the surface of the Msuku uplands, areas of virgin forest exist, and generally along the banks of the larger streams trees of immense girth grow. A prominent exception is formed by the banks of the large and swampy Saisi river, where, on account of the flatness of the land and the ill-defined banks, the country is usually flooded, this preventing the growth of anything but reeds and grass. The population is peaceful, but close to the main roads it is practically *nil*. The usual food-stuffs, such as maize, millet, sweet potatoes, peas, beans, etc., are

TANGANYIKA PLATEAU.

grown. Game is fairly plentiful off the roads, and much slaughtered by the natives by means of pits.

Leaving Kituta and following the lake round the south-east corner and north to the German station of Bismarckburg—formerly Kasanga—we find the country to be generally broken and mountainous, more especially after crossing the Anglo-German boundary at the Kalambo river, from which point it was found impossible to take the telegraph-line into Bismarckburg without climbing over 1000 feet to a step of the plateau, and then descending again very steeply. A few miles from the mouth of the Kalambo river very magnificent falls occur, a large volume of water falling a sheer 600 feet or more over a rocky lip of horseshoe shape. It then winds in a silvery line through a gradually widening but impenetrable valley with progressively lower cliffs until it reaches the lake. It is thus impossible to see the falls except from above, but

the somewhat steep and rugged climb to the upper plateau will always well repay the exertion, as plenty of water flows all the year round. No finer falls, not excluding those of the Ruo, have been seen by the present writer during the ten years he has spent in Central Africa.

Bismarckburg, which is shut in on all sides by mountains, is the southernmost station of the German East African Administration on Lake Tanganyika. A fine well-appointed boma or fort is now being built, and there are quarters for about five German officers and non-commissioned officers, besides a few traders and a number of Sudanese and other soldiers. As at Kituta, the heat is at times almost overpowering—at least, to those whose duty takes them away from the comparatively cool verandahs. On the coast between Bismarckburg and Ujiji there are four stations—Kala, Kirando, Utinta, and Ujiji—all occupied by the Algerian "White Fathers," and possessing fine churches, schools, and other stone buildings.

It was soon apparent that the telegraph would once again have to scale the mountains and reach the plateau, the coast-line north of Bismarckburg being quite impossible. This plateau I found very beautiful, being high, well watered, and grass-covered to a large extent, with pretty hills covered with grass and trees rising on each side; the country seemingly fertile, but somewhat sparsely inhabited. I travelled first along the country to the east of the telegraph-line, following a native path; but, finding the Fwisi and its tributaries very swampy, I decided to keep on somewhat rougher country to the west, more nearly on the watershed between Tanganyika and the Fwisi, which flows into Lake Rukwa. As it was imperative to again skirt the lake at Karema, I had reluctantly to leave this high ground when east of Kirando, and gradually descend again through fairly well-timbered country. The natives of this district are well clothed, being supplied by the Arabs with coloured cloths, white calico, and beads, in exchange for the rubber collected by them, mostly in the virgin forest which fills up the ravines draining into Lake Tanganyika. There was hardly a village where two or more of these born traders were not found. As is the case with nearly all the mountain-girt lakes of Central Africa, the tribes inhabiting the shores are different from those on the higher mountain slopes or plateaux, and were it not for the presence of officials at Bismarckburg and Ujiji they would be constantly raiding and counter-raiding as of old. As it is, they now carry on a more or less friendly barter of fish on the one hand for salt and iron on the other. North and east of Karema is a wide and comparatively flat country, generally well-timbered, but swampy here and there in the rainy seasons and waterless in the dry. Mimosa-thorn trees abound, and giraffe are plentiful. On the lake and in the neighbourhood of Katunka's the population is large. This Katunka is a powerful chief, noted for the murders he has committed, and is a constant source of trouble to the German officials.

The rough nature of the country north of Katunka, together with the configuration of the lake-shores and the swamps between Karema and Katunka, again necessitated the continuance of the survey on the higher land, and only after a wide extent of country had been examined was it possible to get the better of the swamps, virgin forests, and a number of extraordinarily deep ravines or cañons that had to be manœuvred between Kapurola and Mulire. The natives, too, gave constant trouble, numbers not having seen, and few having before worked for, a white man. They preferred hunting the large herds of elephants and other game roaming about, or collecting rubber, to the more monotonous and restricted work demanded by Europeans, and, being well armed, they

LAKE TANGANYIKA, KITUTA.

had no hesitation in saying so. They are well clothed in Arab clothes, own a few cattle and large herds of goats and sheep, while their villages are extremely well stockaded. They do not paint, but the women wear large ear and lip rings. Kapurola is a big and quarrelsome chief, and has likewise given considerable trouble to the Ujiji officials. When last seen by the author he was a refugee a few miles up the right bank of the Luajeri river, on a small rising ground surrounded by an almost impenetrable swamp of reeds.

The Lugufu, Malagarasi, and Liuchi rivers all overflow their banks and are very swampy in the rainy season. The Malagarasi is probably the largest river flowing into the lake. All these rivers are full of crocodiles and hippopotamuses, which in the rainy season are found near their sources.

Between Maswa and Ujiji the population is large, and the country by the lake opens out, terminating at Ujiji in undulating ground. This, however, is much cut up by sharp and comparatively deep ravines, the nature of which can only be judged by walking over the country away from the winding but well-engineered paths of the natives. All along this coast swamps at lake-level lap into the land —just dry from July to November and December, and impassable the rest of the year.

Leaving Ujiji in August, 1901, the expedition crossed a minor but still swampy branch of the Luichi river, and after getting over some low but very broken country, the Luichi itself, at a place where it had a considerable fall, with well-defined banks and no overflow. Then a mountain with steep face was climbed, and a lovely and cool plateau reached, densely populated, well watered, and supporting large herds of cattle. The natives were friendly, wore skins and copper and wooden bracelets, of which, however, the latter only were seen by the author. Their huts were particularly well constructed, and not stockaded. A descent was made somewhat abruptly, and with much reluctance, to the valley of the Msukwe river, the country then alternating between grass-covered and well-wooded land, until the Malagarasi was reached on August 31. It seemed scarcely smaller than when crossed at its mouth. After crossing the river and following up its left bank for some distance, sometimes on dry and other times over muddy land, our route left it, and some undulating, well-timbered, but quite dry country was crossed. This brought us to the Mugana river, quite dry at the time; and a few miles further on the Mtindi was crossed. This, in the wet season, is in itself 5 miles broad, and forms a huge swamp, extending down to the Malagarasi and up-stream for some 50 or 60 miles or so from this crossing. The Mtindi was crossed at a favourable place on September 6, and even here, before the other side was reached, seven channels had to be crossed, the largest 300 yards in width, and with 4 feet 6 inches depth of water. In the rainy season, the entire country between the Mugana and the Mtindi river is under water—a width of 14 miles, with a maximum depth of 7 feet. The Mtindi never dries up, and is only fordable at one or two places for about three months in the year. This far from pleasant natural barrier divides the people of Uha on the right bank from the Wasumba and Wahinga tribes on the left.

Between the Mtindi river and the south of Smith sound of the Victoria Nyanza, the country is, apart from the paths and native clearings, largely covered with an almost impenetrable thorn scrub. The trunks or limbs of the bushes are up to 8 inches in diameter, with thick minor branches and shoots, the whole densely interwoven and covered with very formidable thorns. In the dry season there is no surface or running water whatever, the natives all resorting to wells dug to a

depth of about 20 feet; needless to say, that towards the end of the dry season the stuff contained in them is far from refreshing. The Kagoni river is seemingly dry for five or six months during the year.

The villages are generally large and well kept, the natives peaceful and well clad. They trade largely in conjunction with the Tabora Arabs, for whom they travel great distances in search of ivory. Cattle are plentiful, and are all of the humped variety. The Swahili language is understood by nearly all the elder men, headmen, and chiefs. Between the Mtindi river and Smith sound, the author found most encouraging signs of civilization—more, indeed, than he had previously witnessed in Central Africa. The chiefs are designated "Sultani."

BAOBAB TREE NEAR SLEEP BAY.

Kapula village—formerly Ghiya—was visited by Speke and Grant in 1861, and by Stanley in 1876. Here hilly country commences, the hills being well covered with timber, the plains alternating between grass and the aforementioned thorn scrub, the former swampy in the rains. Between Ngombe and Mpina villages, the country, which is drained directly into Smith sound, is dotted over with low timber and grass-covered hills. It is nearly all very rocky, with boulders of gneiss, and is so flat that practically all the plains up to the lower slopes of the hills are under water during, and for some time after, the rains. The ground crossed in September was hard baked, and so cracked that, after a careful mental calculation, the void made by these fissures was found to exceed the area of the earth surface. The heat, with the

unpleasant and distorting vibrations of the atmosphere above these parched plains, together with the enforced slowness of our progress, rendered travel anything but a pleasure. It was impossible, except at long intervals, to satisfy the intense thirst of the caravan, and then, with what! Game, curiously, was plentiful, ostriches, *Gazella Thomsoni*, and topi being most in evidence.

Further on the plains, undulating somewhat, became at parts densely populated, and immense herds of cattle were everywhere seen, all seemingly plump and in good condition, though apparently being fed only on the very dry grass then existing. At places, of course, *e.g.* at Stuhlmann sound and the other point of Smith sound, the route led close to water, and then green vegetation could be found all the year round. The natives were now found to wear little or no calico or cloth, but were more or less clothed in skins. Stony kopjes are freely dotted about this land, and huts and lean-to's are built on them. The Simiyu, a large river with flowing water, was crossed 15 miles from Nassa, a station of the Church Missionary Society. The station had then a clerical and a lay missionary, the former being away at the German station of Mwanza at the time of my visit. The buildings had seen better days, and little missionary influence seems to have made itself felt among the natives.

After a much-appreciated rest of two days, a further start was made along the shores of Speke gulf. The country soon became less flat, rising perceptibly away from the lake, and becoming covered with bush and timber. It was thinly populated except close to the lake, and seemingly dry and waterless inland. Crossing the river Balagete, in which a considerable body of water was flowing, the caravan traversed a flat, and in the rainy season swampy, country, now intersected by cracks, and then crossed the Luwana, a nearly dry but broad and deep river-bed at the foot of a mountain range. The numbers and variety of game seen in this plain were almost incredible—buffalo, gnu, hartebeeste, water-buck, topi, mswala, *Gazella Granti* and *Thomsoni*, and immense herds of zebra predominating. Climbing the escarpment, we reached Kiteresia village, and then proceeded over grassy and undulating plateau lands, well watered and thickly populated. A descent was made from Madutu village, and another very large but better-drained plain was reached, containing miles upon miles of grass land teeming with game, and, best of all, without cracks. Somewhere about the middle of the plain an island of thick thorn scrub was seen, and from it, to every one's surprise, a number of natives—afterwards found to be refugee Sotik people—issued, carrying long swords and formidable-looking Masai spears. They were nude, painted with plain and coloured clay, the men averaging over 6 feet high. They advanced towards the caravan, all the members of which, except the writer, were unarmed. This, our unwarlike appearance, and the evident surprise expressed,

together with a large quantity of meat we had with us, saved the day, as not a single word could be understood between the two parties, all subsequent communication being carried on by signs, a very humorous spectacle. Even such words as fire, water, river, common over a large area of Africa, were in every case used by the writer's cosmopolitan caravan without any sign of recognition on the part of our new acquaintances. Their hair was made up into two or three pigtails slightly erect, greased, and thickly coloured with brilliant vermilion, making a distinctly fantastic coiffure.

After climbing up the face of another very steep escarpment, the village of Mutaga was reached, and it became evident that the natives now saw a white man for the first time. Continuing along the well-watered and timbered plateau, broken by outcrops of gneiss, on which we found a fairly large population, we made another descent, and crossed a well-timbered valley drained by the large river Mala. This river was found to divide two by no means friendly tribes, for whilst encamped at Marua's village on the right bank we saw a small foraging party return from a stealthy visit to some villages on the other side, carrying spears, bows, and poisoned arrows, and having amongst their number some badly wounded men, one with an arrow through his chest. About here the topi—an antelope probably nearly akin to the hartebeeste—and marabout stocks were everywhere visible.

Another stiff climb up the face of the escarpment brought us to a large grass-covered undulating plateau, with a gradual slope towards the west, as usual well watered, and fairly thickly populated by the Walianjoka tribe, who possessed immense herds of cattle. Beyond Utende village, a well-timbered but uninhabited country was met with, and, apart from a party of professional elephant-hunters, no natives or villages were met with until the large Mori river was crossed. In this solitude large herds of elephants made their home, roaming about the country both on the level ground and on the steep slopes of the higher portions of the escarpment to the east. After crossing the Mori river we mounted gradually to the higher slopes of the plateau, which were again undulating, grassy, and especially well watered. The natives, a different tribe from those beyond the Mori, were found to be quite nude, both male and female, the former elaborately painted. Their villages were all enclosed by mud walls about 18 inches thick and some 5 feet in height, the huts primitive, and built largely of solid mud. The soil about here is of a brilliant red. Immense herds of cattle, goats, and sheep thrive well. The size of these savages, and the brilliant and variously coloured patterns painted on their faces, together with an easy and withal graceful bearing, make an imposing impression, while their countless numbers make them a formidable tribe. During this time great difficulty was found in keeping on friendly terms with the natives and at the same time feeding the

carriers; language on both sides was quite unintelligible, and, to complicate matters, calico, coloured cloth, and beads were in such plenty as to be quite at a discount among them.

A gradual descent to Kavirondo bay, with a dense population on all sides, brought us to the Kavirondo tribe proper, very similar to those of the mud walls, their dress being quite the same, while they owned large herds of cattle as before. It very soon became evident that a white man was now no longer a stranger, though not until the swampy and papyrus-grown shores of Kavirondo bay had been well rounded and Kisumu nearly reached was there any outward appearance to indicate that the great Uganda railway was already laid to within some 40 miles of the Lake, or even that white men were only a few miles in front.

Kisumu, the terminus of the Uganda railway, was reached on October 28, 1901.

THE EASTERN BORDERLANDS OF KIKUYU.*

By Captain B. DICKSON, R.A.

Between Nairobi, the capital of the Ukamba Province of British East Africa, and the Meranga district south of Mount Kenya, the country consists, for the most part, of a fairly level triangular plateau, enclosed between the Kikuyu cultivated lands on the north-west, the Kamahua and Boinzero ranges on the east, and Doinyo Sabuk on the south, though in the last direction a part of the same plateau extends to the Lukenya and Mwar hills. The surface slopes from west to east and is drained by numerous streams flowing in deep beds to the Athi or Tana. Both the Athi itself and the Thika, a tributary of the Tana, make their exit between Doinyo Sabuk and the Boinzero range, both becoming broken by rapids and flowing in deep rifts as they enter the more hilly country to the east. At the north end of the plateau the streams pass either through gorges in the Kamahua range or to the north of this. All these rivers take their rise in the Kikua (Kikuyu) hills, from which innumerable streams flow down in deep narrow gorges, and on uniting in the plain at first form papyrus-covered marshes, but are subsequently confined in regular channels, eventually dropping by waterfalls or rapids into valleys or cañons 100 feet deep and varying in breadth from 200 to 800 yards. The actual river-banks are covered with large trees, but the valley-sides are rough and rocky, covered with mimosa trees, long grass and bush, which extend for a little distance over the plain above. During the rains the streams rise to a great height, in the case of the Athi 30 feet in places, so that any attempt to make bridges, except for foot traffic, would be a costly undertaking.

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* Map, p. 108.

The surface of the plateau is flat, grassy, and treeless, mostly inundated during the rains, with a black-cotton soil which cracks badly in the dry season, and, in places, quantities of small stones. Large numbers of game frequent these plains. The watershed between the Athi and Thika is almost imperceptible, but on reaching the latter, the country changes in character, the vegetation becoming quite tropical. North of the Thika the plain, which slopes a little to the north, is rougher than further south, and in the direction of Kenya, patches of long grass and stumpy trees give the country the appearance of a deserted orchard.

The Kikua hills run out towards the plain in a series of narrow spurs, with a direction from north-west to south-east, separated by gorges 100 to 150 feet deep. Wherever the surface is flat swamps are found, probably owing to the enormous rainfall, but they could be easily drained. Where not cultivated, they are covered with a thick growth of Sodom-apple and long grass, and are sparsely timbered, except along their margin, where a thin fringe of forest divides them from the plain. This, probably, once extended over the hills, but has been destroyed by the annual grass burnings. At one time all the hills were cultivated, but since the famine a few years ago, the Wakikua have moved to the west, leaving the eastern side of the highlands uninhabited, although there are still some few potato patches, and bananas still grow by the watercourses. The soil, which has been formed from the volcanic rocks of which the hills are composed, only needs cultivating to grow almost anything, while all the main streams are perennial. The climate is raw and cold at night, with heavy dew on the hills, but generally hot by day. Travelling is difficult, except by the tracks following the spurs, which the Wakikua use in visiting the plains. There is, however, a fairly good road from Nairobi to the Meruka country, and though the river gorges are an obstacle, the streams are all fordable. Fuel and wood of any sort are very scarce. There is no four-footed game, but quantities of guinea-fowl and partridges. The natives, though seemingly friendly, are apt to be treacherous. They never appear to cultivate much more than they require for their own wants, and they have consequently very little spare food to barter. The women work in the fields, but the men clear the ground, cut wood, and build houses, the boys tending the stock, which consists of cattle, goats, and sheep. The women wear leather aprons, and adorn themselves with iron or brass wire bracelets and garters, as well as with beads and earrings; but the men wear practically no clothes, except sometimes a loose blanket. They carry a spear, sword, and knobkerry, and (near Meruka and Mbirri) bows and poisoned arrows.

Owing to the hostility of the natives of Meruka, it was impossible to traverse this district thoroughly, but it appears that the passage from

the cultivated hills to the plains is here more gradual, there being no dividing line of forest.

The long range of hills which forms a wall between the Athi plains and the lower Tana valley is dry, rocky, and bush-covered, with the exception of the north-west slopes of Kamahua, which are covered with bean-fields and villages. They are thickly wooded on the east, but grassy on the west except along the water-courses. There is very little water in the dry season, and what little there is runs down on the north-east side into the Tana. There are, however, some large flats below the south-west slopes of Boinzero, which, by the aid of a few dams for irrigation, could be made into fine farm land. The hills are covered with quartz, but no sign of metals was seen.

North of the Tithara the plain gives place to small hills and valleys, with cultivation and villages interspersed with bush, which continue till we reach Mbirri. This country is not so well drained as further south, most of the valleys containing wide and deep swamps, which appear never to dry up, as they are fed by numerous springs in the hills round Kinankop. The country is very fertile, and with a little labour would grow almost anything, but there is practically no wood, only an occasional big tree, though higher up towards Kinankop large belts of forest are said to occur. In places the hills are rocky, and form precipitous gorges overhung with trees and creepers. The principal river is the Maragua, which runs due east from Kinankop. It forms a series of rapids, and on crossing the Mbirri road runs through a cañon 200 feet deep, but this soon opens out into a flat valley covered with cultivation and villages, the river being here fringed with large trees. There are a few deep fords at long intervals.

North of the fort at Mbirri is a long range of hills running from west to east, with the three prominent peaks, Katuri, Kanjuyu, and Kanbicho. It is bounded on the south by the Marathwa and on the north by the Tana, these two rivers uniting at the foot of Kanbicho. The hills are rough and rocky, strewn with quartz boulders and covered with bush, and as there is no water on them it is unlikely that they could be of much use for agriculture. They are uninhabited.

North of the Tana we find the Meranga country, a large district extending up to Mount Kenya—or, as the natives call it, Miru—which lies some 60 miles away to the north-north-east. The country, which near the Tana is level, afterwards rising gradually in a series of small hills, is very rich and fertile, and is covered with villages, beans and bananas being the chief products. Famine and drought are unknown. The Tana is said not to overflow here in the rains, although the country for some 2 or 3 miles is level with its banks. Towards the west, and up the slopes, cultivation gives place to scrub and Sodom-apple. Manga, the chief of Meranga, lives in a large village about a mile north of the Tana, and is a very friendly old man. His

village, once a great slave-trading centre, is still a great centre for the native caravans which go into northern Meranga and the Wanderobo country for ivory. There are good roads, used by the natives when driving their cattle from one grazing-ground to another.

To the south-east of Meranga, a wide grassy plain, relieved here and there by bush-covered hills, extends to the Tana. It is marshy in the rains, but was absolutely dry when I crossed it. The Rupiangasa, which traverses the centre of the plain, is a largish river. The lower ground is mostly black-cotton soil, which gives place on higher levels to red soil. There is thick bush for about a mile on each side of the Tana, with large tropical trees on the river-banks. South of the Tana the country slopes up to the Ithanga hills, most of the watercourses being dry in the dry season, but torrents during the rains. Game is here plentiful. To the south, on each side of the Thika, there is very dense thorn bush, the natives never coming here for fear of the numerous rhinoceros. At the northward turn of the Thika there are some very curious needle-like hills, each formed of a solid mass of rock. The water-parting between the Tana and Athi is ill-defined, but further east the ground slopes gradually upwards from the Tana to the group of hills commencing with Kangondi, whence again a long sloping plateau falls south-east to Kitui, beyond which a more sudden slope occurs. This plateau is broken by several watercourses (some dry), all leading to the Tiva, itself for the most part a dry river-bed which is at last lost in the sands some 100 miles down. In the dry season, all these streams merely form pools of stagnant water, which are nearly always salt and undrinkable. There are very few fresh springs in the country. The surface covering varies between bush, grass, and, finally, forest, till the river marked "Y" in the map is reached. On the south-east side of this stream (which has a dry bed with salt pools at intervals, lying in a deep, wide valley) cultivation commences and continues in patches up among the hills to the north-east, near the huts and villages of the Wakamba. Wood is scarce, and the soil is mostly red and sandy, with much quartz and mica.

THE VOYAGE OF THE "GAUSS" FROM CAPE TOWN TO KERGUELEN.

The second number of the joint publication of the Geographical and Oceanographical Institutes at Berlin is devoted to the reports sent home from Kerguelen by the German Antarctic Expedition. These show an excellent record of solid work on the voyage of the *Gauss* from Cape Town to Kerguelen, and they contain some interesting particulars of the voyage and the vessel.

The stay at Cape Town was somewhat longer than was anticipated, as the ship was leaking considerably, and a good deal of caulking had

to be done. The ventilating arrangements had to be supplemented, and large additional purchases of crockery, glass, and laboratory apparatus had to be made to supply the loss by breakage, so that it was December 7 before the ship was ready to leave.

It is pleasant to read Prof. von Drygalski's hearty appreciation of the courtesy and kindness shown to the expedition when at Cape Town, not only by their compatriots, but by the colonial and military authorities and the scientific societies. Various changes were made in the crew before sailing, and some at least of the new recruits were not of German nationality.

Bad weather was frequent on the twenty-four days' voyage to Kerguelen, but it was found possible to take thirteen soundings, the particulars of which it is worth while to reproduce, translating the metric depths and Centigrade temperatures to our familiar units.

Lat. S.	Long. E.	Depth in fathoms.	Bottom temp. Fahr.	Salinity per mille.	Deposit.
37° 41′	20° 47′	2570	34°·2	34·65	—
39° 42′	24° 49′	1676	36°·0	34·69	—
40° 0′	27° 13′	1706	36°·0	34·67	Traces of globigerina.
42° 30′	33° 45′	2780	36°·9?	34·51	Globigerina ooze. Much clay.
43° 4′	36° 22′	1980	34°·4	34·56	" "
44° 18′	41° 48′	1342	35°·8	—	" "
44° 41′	43° 54′	995	36°·3	34·51	—
46° 18′	48° 51′	1020	35°·8	34·58	Globigerina ooze and volcanic sand.
46° 48′	50° 31′	1277	35°·4	34·56	Volcanic mud.
46° 40′	51° 23′	149	—	33·84	Coarse pieces of volcanic rock.
47° 12′	58° 8′	2674	32°·4	34·45	Globigerina ooze and volcanic material.
47° 46′	61° 23′	2512	32°·6	—	" " " "
47° 51′	66° 32′	210	35°·4	33·91	Hard ground.

These depths, though not great, are considerable, and they are important as occurring in places where almost no soundings had been made previously.

As the Crozet islands lay right in the route of the *Gauss*, it was resolved to attempt a landing on one of the group, a feat that has been rarely attempted, and still more rarely accomplished. On Christmas Day, 1901, the landing was made on Possession island, in one of the ten little bays which indent that part of the coast which stretches from south-west to north-east. Of the landing Prof. von Drygalski says—

"Outside the bay we were caught by a whirlwind rushing out from the valley leading down to the bay, and lashing the water into foam; then we came into quiet water, between far-reaching fronds of tangle (*D'Urvillia*), and landed easily and safely on a low basalt rock, amongst slumbering sea-elephants, marshalled troops of donkey penguins, white Chionæ fluttering round devoid of fear, cormorants and storm-fowls skimming swiftly over our heads—in short, we stepped

into an idyll of wild creatures, which said clearly enough that no human foot had ever before trod this solitary strand, whose inhabitants resented the intrusion, if at all, only by helpless movements. The sea-elephants raised their heads, and roared when one almost trod on them, the penguins marched forward a short distance supported by their tails, and the Chionæ ran a few steps only to settle on the nearest stone."

Time was short, and the scientific staff of the *Gauss* lost none in sentiment. Specimens of everything the island afforded, animate or inanimate, were speedily gathered, and very interesting collections they proved to be when examined at leisure by the various specialists. The island was of volcanic formation, alternate layers of tuff and basalt; but the gentler slopes and level places were thickly clothed with vegetation, especially mosses, which in parts formed morasses difficult to cross. The visit only lasted a few hours, and the voyage was resumed, Kerguelen being reached on the last day of the year.

The *Gauss* was again leaking, the sound of the water washing about under the plates of the engine-room floor having sometimes been quite distressing; but there was no real danger at any time, and the leaking was stopped while the vessel lay at the island. Instead of meeting the steamer from Sydney, and the Kerguelen Land party at Three Island harbour in Royal sound, the *Gauss* only found a German flag fluttering over a message which stated that the station was established in Observatory bay, on the site of that occupied by the British transit-of-Venus party. Hither the ship went, and found the Kerguelen party very imperfectly installed and the Australian steamer gone, leaving the coal and stores on the beach. Hard work was the lot of all on board in loading up the *Gauss* for her southward voyage, and finishing the house and observatory for the party who stayed behind to carry on simultaneous magnetic and meteorological observations. In addition to Herr Enzensperger and Dr. Luyken, the magnetician and meteorologist, with a sailor who accompanied them, the biologist of the *Gauss*, Dr. Werth, stayed at Kerguelen with a second sailor, making up the number of the land party.

The *Gauss* had on board altogether over 400 tons of coal, 158 tons of it Welsh, 209 tons New Zealand, and 40 tons of anthracite for the stores and for the land station, which it was hoped to establish in the Antarctic region. The provisions on board would supply full rations until August, 1904, while the vegetables would last much longer; so that, taking into account the fresh seal and penguin meat sure to be met with, there is no fear of want for three years at least. All the equipment and the ship herself were absolutely satisfactory. The sledge-dogs taken on board at Kerguelen were in the best condition, and greatly pleased the leader of the expedition. With the highest hopes and the greatest confidence in themselves and their plans, the expedition left Kerguelen on January 31, 1902, straight for the

unknown. The plan included a possible landing on Heard island, and then a straight run for the position of Wilkes' Termination Land, whence the edge of the ice was to be followed westward, and the first opportunity taken to get south. The place of the wintering station Dr. v. Drygalski promises to tell when he comes back. It is interesting to note that the *Gauss* is the first ship to attempt to follow the alleged track of Morrell, whose vague narrative showed that he claimed to have passed from near Enderby Land far southwards, emerging in Weddell sea. The Kerguelen station is to remain in activity until March 1, 1903, from which date the members will be ready to embark at short notice when sent for from Australia.

The dispatches which made up this most interesting report were brought from Kerguelen on April 2 by the German steamer *Essen*, which called specially on a voyage from the Cape to Australia.

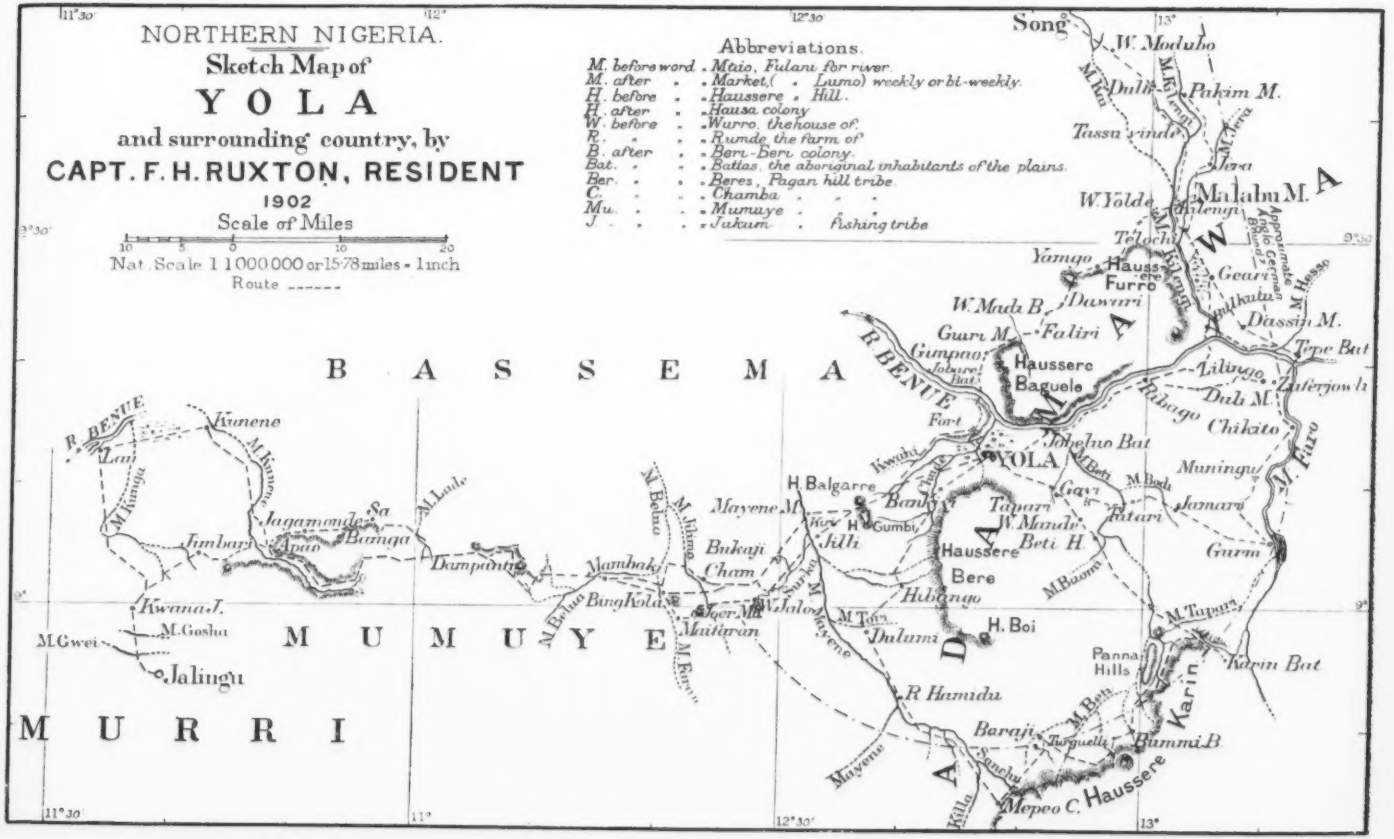
The greatest credit is due to the authorities in Berlin for so promptly publishing these full reports, illustrated by photographs and maps, for it is surely a record in scientific publication that reports written in Kerguelen in April should be published in Berlin in August.

YOLA.

By Captain F. H. RUXTON.

THE accompanying sketch shows the country situated on the upper Benue, now designated as the province of Yola. This part of Northern Nigeria fell under our sphere of influence by the Anglo-German Agreement of 1893, and was effectively occupied in September of last year. The routes were roughly sketched during the dry season of 1901–1902.

Barth was the first to enter this country, in 1851, coming from Kukawa, the then capital of Bornu; he was only allowed to remain a week, being forced to return by Mohammed Lowel, a half-brother of the present Emir. Since then many travellers have given descriptions of their travels through Adamawa, notably Dr. Passarge. All, however, were compelled to follow the main trade roads, and never penetrated into these mountain fastnesses where the pagan aborigines still hold their own against the Mohammedan Fulani raiders. The ethnology of these various peoples—Mumuyes, Battas, Beres, etc.—untouched by outside influences, would be of the greatest interest, and would well repay study on the part of competent observers. The physical features of the country may be briefly described as consisting of the basin of the Benue, with hills running in more or less parallel ranges to the course of the river. These ranges increase in height as they recede from the river until, in the south, they reach the dignity of mountains and form the watershed of the Benue and Atlantic streams. These hills, granite in composition, are mostly barren and devoid of verdure; for though their summits and slopes are often inhabited by wild pagan tribes, their


NORTHERN NIGERIA.
Sketch Map of
YOLA
and surrounding country, by
CAPT. F. H. RUXTON, RESIDENT
1902
Scale of Miles
10 5 0 10 20
Nat. Scale 1 1000000 or 15·78 miles = 1 inch
Route ------
Abbreviations.
M. before word . Mtaio, Fulani for river.
M. after . Market, (. Lumo) weekly or bi-weekly.
H. before . Haussere . Hill.
H. after . Hausa colony
W. before . Wurro, the house of.
R. . . Rumde the farm of
B. after . Beri-Beri colony.
Bat. . . Batlas the aboriginal inhabitants of the plains.
Ber. . . Beres, Pagan hill tribe.
C. . . Chamba . . .
Mu. . . Mumuye .
J. . . Jukum . Fishing tribe
B A S S E M A
M U R R I
M U M U Y E
D A K A K A R I
W A D A M A
YOLA
Song
W. Modubo
Pakim M.
Tassa'ande
Malalm M.
W. Yolde
Yamgo
Haussere Furro
W. Mada B.
Dawarri
Guri M.
Faliri
Gumpao
Haussere Baguele
Dassim M.
Tepe Bat
Lilingo
Zaferjonla
Dali M.
Chikato
R. BENUE
Kunene
Lai
Jagamonde
Banga
Jimbang
Dampanna
Mambak
Bukaji
Cham
Mayene
H. Balgarre
Gumbi
Jilli
Haussere Beti H.
Bere
Hidango
Tapura
W. Mandu
Jamaro
Gurm
Muningu
Farro
Chikato
Kwana I.
M. Gosha
M. Gwei
Jalingu
Mutiran
Dulumi
H. Boi
M. Tapura
Pannai Hills
Karin Bat
R. Hamidu
Baraji
Turguelli
Bummi B.
Haussere
Mopeo C.
Killa
Mayene

cultivation is mostly done in the small secluded valleys that abound in these mountain masses. The flat-topped hill, so characteristic of Africa, and especially of the valley of the Niger, is hardly seen, though single sugar-loaf cones are often met with to the north of the river in the neighbourhood of Song.

The alluvial valleys of the Benue and its large tributary, the Faro, consist of rich low-lying lands, covered with a tall rank grass, and subject to yearly inundations of great extent in the rainy season. The general level of the country is low, the town of Yola, 750 miles up-river, being only 656 feet above sea-level according to Flegel's observations. In general appearance the country may be said to consist of scrubby veldt, and to much resemble parts of Rhodesia. The rainy season sets in at the beginning of April, and continues to the end of October, the rivers reaching their highest level about September 1. Though the Benue is then of great depth, navigation is much obstructed by sand-bars, so that only steamers drawing 8 feet of water can reach Yola, and then only during a short period of the rainy season. The smallest stern-wheelers can get up to Yola during five months in the year; but owing to the rocks in the river, the reaches above the town can only be navigated for a still shorter period. The Faro is also available for stern-wheelers, but to a distance not ascertained; its current is much more rapid than that of the main river, and is probably as great as 5 miles an hour. At the end of the rainy season the country becomes much parched, none of the streams being perennial except the Benue, and even that river is fordable in many places, and canoe-navigation as far as Lau is only carried on with difficulty. Water, however, can generally be procured in the bed of the dry watercourses by scooping small holes in the sand.

Yola was the capital of the Fulani state of Adamawa, and formed part of the Sokoto empire. Founded about seventy years ago by Mallem Madebo, after he had consolidated his power, the town is as badly situated from every point of view as it is possible to conceive. In the rains the town is almost completely surrounded by impassable swamps and large flooded areas; in the dry season water is scarce and of the worst description. Except at high water, canoes cannot approach nearer than 5 miles from the town, and it is most inconveniently situated for the land trade. Yola covers a large area, and consists of round mud huts with well-thatched conical roofs, standing in compounds surrounded by mat enclosures. These compounds are often of large extent, inside of which guinea corn is grown. Looking down from the surrounding heights, the site of the town is marked by an oval of foliage, no buildings being seen. Only the Emir and a few of the big men have superior dwellings—mud houses built in the Arab style, and the compounds surrounded by high mud walls. The city is divided into two distinct portions, the larger to the west inhabited by the ruling

Fulanis and their numerous slaves, the smaller by the Hausa traders and other settlers. The town area is not surrounded by walls or any other means of defence; a gateway even does not exist. The Fulanis, no doubt, relied on the open surrounding country, where their cavalry could manœuvre, for their means of defence. Next to Yola the two most important towns in the province are Song and Malabu, each ruled by a vassal of the Emir of Yola. Scattered over the country are colonies of Beri-Beris, immigrants from Bornu during the time of Rabah's wars, and of Hausas. In the hands of the latter lies the trade of the country; irrigation is carried on by them to a small extent at Meyene, Beti, and Dassin, wheat and onions being the principal articles grown. The ethnography of the district is of too varied a character to be touched on in the space at disposal; suffice it to say that since the Fulah conquest a century ago, slave-raiding has denuded many fertile districts of their indigenous inhabitants, but now there is every reason to hope that the advent of settled government may engender that feeling of security which alone can restore the former prosperity of this fertile land.

THE CHILE-ARGENTINE ARBITRATION.

Whilst all the civilized world has been occupied in watching the progress of events in South Africa, very little interest has been shown in political developments in South America. And yet it may be doubted whether, from the purely financial point of view, the attainment of a peaceful issue to the recent boundary dispute between Chile and Argentina is not quite as important to England as the assurance of peace in South Africa. The amount of British money expended over the war cannot differ largely from the amount of capital invested in South American securities generally; in either case, that amount totals up to something over two hundred million sterling. But the two hundred million which the tax-payer has contributed towards the South African war expenses has so largely returned to the tax-payer's country (if not to his pockets), that it is very doubtful whether one-tenth of that sum has really benefited foreign countries. Contractors and ship-owners have grown rich upon it, and in the great majority of cases these contractors and ship-owning firms are British. Cape Town and Durban, aided by the wealth which has been poured into them lately, should expand from the status of second-class provincial towns into centres of civilized development more nearly approaching to that which has already been attained by Buenos Aires in South America; and their rise, together with the general advance of all the chief centres of administration in South Africa, will surely reflect again on British prosperity, and prove an indirect, if not a direct, gain to British finance. In the long run, the cost of the war in South Africa will very

NEW BOUNDARY BETWEEN CHILE AND THE ARGENTINE REPUBLIC.

possibly prove to be a good investment of capital. But what would be the result of a war in South America? Most of the British capital already invested would probably be safe, although some of it would certainly be imperilled; but South American investments generally would sink indefinitely in value; there would be collapses on the Stock Exchange, and undoubtedly the interest of the vast sums sunk in South American railways and other public works would be wanting so long as the war lasted, if not for ever. In short, a war between Chile and Argentina, which would have all the bitterness of a civil war, and would be fought on the lines of a European campaign out to the end by two countries possessing numerous and well-equipped armies backed by powerful fleets, whose strength in armour and armament has been carefully balanced for years, would not only spell ruin and disaster to both the countries concerned (no matter which of them had the best of it), but would prove a most costly complication for England. King Edward's award, therefore, which closes a dangerous episode of international dispute of more than half a century's duration; which establishes a happy prospect of peace, and points to a period of internal development which will vastly strengthen the financial position of both countries, is an immense gain to this country, and is of none the less value because it has cost the country nothing at all. The expenses connected with arbitration are equally shared by the two republics concerned.

The map illustrates the nature of the award. It shows a dividing-line between the two claims which assigns the more northern districts of the disputed area to Argentina, and the southern districts to Chile. It would appear from the map that Chile has gained something in area, but in a mountainous region such as the Southern Andes, where by far the greater part of the country consists of unprofitable mountain slopes, the actual extent of the award on either side has no significance. The Welsh colony of "16 Octubre," together with the contiguous valleys of Nuevo and Cholila, which now definitely become Argentine territory, are valleys of great promise for pastoral and agricultural purposes, and will undoubtedly prove a most valuable addition to those magnificent fields of pasture land which already make Argentina the finest meat-producing country in the world. In amongst the rugged hills, clothed with beech forest from the snow-line to the flats, there is many another comparatively narrow band of grass country which, in the hands of a capable colonist, will develop a rich pasturage, just as the pampas-grass covered flats of the provinces have turned into broad acres of almost inconceivably rich herbage in response to the demands of the cattle turned on to them. It yet remains to be seen what will *not* grow in those Southern Andine valleys under the influence of the warm sun and soft mists of the Pacific. It is a great mistake to suppose that the Southern Andes will not repay the costs of arbitration many hundred-fold. Chile gains a large area of forest country, and a good many

square miles of wool-producing upland. Southern Patagonia is already making an impression on the wool market, and there is nothing now to hinder its growth. The want of title to the land has been the great difficulty with sheep farmers hitherto, as they have been afraid to sink capital on their holdings so long as their tenure was insecure. There is at least one town in this southern province of Chile of which the world will hear more in future. Punta Arenas is already the port of call of nearly all steamers rounding the South American continent, and is, in municipal enterprise, well ahead of most South African ports. Punta Arenas, with a wool-developing Chilean province behind it, will become an important item in the world's commercial geography.

The following are the recommendations of the Arbitration Tribunal, recommendations followed by King Edward VII. in giving his decision :—

There are four distinct subjects upon which we are called upon to make recommendations, viz.—

1. The region of the San Francisco pass in lat. 26° 50′ S., approximately.
2. The Lake Lascar basin, in lat. 40° 10′ S., approximately.
3. The region extending from the Perez Rosales pass, in lat. 41° S., approximately, to the vicinity of Lake Viedma.
4. The region of Last Hope inlet to the 52nd parallel of south latitude.

Our recommendations upon these four subjects are as follows: *—

The San Francisco Pass.—The initial point of the boundary shall be the pillar already erected on the San Francisco pass. From that pillar the boundary shall follow the water-parting which conducts it to the highest peak of the mountain mass, called Tres Cruces, in lat. 27° 0′ 45″ S., long. 68° 49′ 5″ W.

Lake Lacar.—From the point of bifurcation of the two lines claimed as boundaries respectively by Chile and Argentina, in lat. 40° 2′ 0″ S., long 71° 40′ 36″ W., the boundary shall follow the local water-parting southwards by Cerro Perihueico to its southern termination in the valley of the river Huahum. From that point it shall cross the river in long. 71° 40′ 36″ W., and thenceforward shall follow the water-parting, leaving all the basin of the Huahum above that point, including Lake Lacar, to Argentina, and all below it to Chile, until it joins the boundary which has already been determined between the two republics.

Perez Rosales Pass to Lake Viedma.—The southern termination of the boundary already agreed upon between the two republics north of Lake Nahuel Huapi is the Perez Rosales pass connecting Lago de Todos los Santos with Laguna Fria. Here a pillar has been erected. From this pillar the boundary shall continue to follow the water-parting southward to the highest peak of Mount Tronador. Thence it shall continue to follow the water-parting which separates the basins of the rivers Blanco and Leones (or Leon) on the Pacific side from the upper basin of the Manso and its tributary lakes above a point in long. 71° 52′ W., where the general direction of the river course changes from north-west to south-west. Crossing the river at that point, it shall continue to follow the water-parting dividing the basins of the Manso above the bend, and of the Puelo above Lago Inferior, from the basins of the lower courses of those rivers, until it touches a point midway betwe n Lakes Puelo and Inferior, where it shall cross the river

* All co-ordinate values expressed in terms of latitude and longitude are approximate only, and refer to the maps attached to this report. Altitudes quoted in the text are in metres. Where the boundary follows a river, the "thalweg" determines the line.

Puelo. Thence it shall ascend to, and follow, the water-parting of the high snow-covered mountain mass dividing the basins of the Puelo above Lago Inferior, and of the Fetaleufu above a point in long. 71° 48′ W. from the lower basins of the same rivers. Crossing the Fetaleufu river at this point, it shall follow the lofty water-parting separating the upper basins of the Fetaleufu and of the Palena (or Carrenleufu or Corcovado) above a point in long. 71° 47′ W., from the lower basins of the same rivers. This water-parting belongs to the Cordillera, in which are situated Cerro Conico and Cerro Serrucho, and crosses the Cordon de las Tobas. Crossing the Palena at this point, opposite the junction of the river Encuentro, it shall then follow the Encuentro along the course of its western branch to its source on the western slopes of Cerro Virgen. Ascending to that peak, it shall then follow the local water-parting southwards to the northern shore of Lago General Paz at a point where the lake narrows in long. 71° 41′ 30″ W. The boundary shall then cross the lake by the shortest line, and from the point where it touches the southern shore it shall follow the local water-parting southwards, which conducts it to the summit of the high mountain mass indicated by Cerro Botella Coste (1890 metres), and from that peak shall descend to the Rio Pico by the shortest local water-parting. Crossing that river at the foot of the water-parting, in long. 71° 49′ W., it shall ascend again in a direction approximately south, and continue to follow the high mountain water-parting separating the upper basin of the Rio Pico above the crossing from the lower basin of the same river, and from the entire basin of the Rio Frias, until it effects a junction with the continental water-parting about the position of Loma Baguales, in lat. 44° 22′ S., long. 71° 24′ W. From this point it shall continue to follow the water-parting dividing the basins of the Frias and Aisen rivers from that of the Senguerr until it reaches a point in lat. 45° 44′ S., long. 71° 50′ W., called Cerro de la Galera in the map, which marks the head of an affluent flowing south-eastwards into the main stream of the river Simpson or southern branch of the Aisen. It shall descend this affluent to its junction with the main stream, and from this junction shall follow the main stream upwards to its source under the mountain called Cerro Rojo (1790 metres) in the map. From the peak Cerro Rojo it shall pass by the local water-parting to the highest summit of the Cerro Ap Ywan (2310 metres). From Cerro Ap Ywan it shall follow the local water-parting determined by the promontory which juts southwards into Lago Buenos Aires in long. 71° 46′ W. From the southern extremity of this headland the boundary shall pass in a straight line to the mouth of the largest channel of the river Jeinemeni, and thenceforward follow that river to a point in long. 71° 59′ W., which marks the foot of the water-parting between its two affluents, the Zaballos and the Quisoco. From this point it shall follow this water-parting to the summit of the high Cordon Nevada, and shall continue along the water-parting of that elevated cordon southwards, and thence follow the water-parting between the basins of the Tamango (or Chacabuco) and of the Gio, and ascend to the summit of a mountain known locally as Cerro Principio, in the Cordon Quebrado. From this peak it shall follow the water-parting which conducts it to the southern extremity of the headland jutting southward into Lago Pueyrredon (or Cochrane), in long. 72° 1′ W. From this headland it shall cross the lake, passing direct to a point on the summit of the hill, in lat. 47° 20′ S., long. 72° 4′ W., commanding the southern shore of the lake. From this summit it shall follow the lofty snow-covered water-parting, which conducts it to the highest peak of Mount San Lorenzo (or Cochrane, 3360 metres). From Mount San Lorenzo it shall pass southward along the elevated water-parting dividing the basin of the river Salto on the west from that of the river San Lorenzo on the east, to the highest peak of the Cerro Tres Hermanos. From this peak it shall follow the water-parting between the basin of the upper Mayer on the east, above the point where that river changes its course from north-west

to south-west, in lat. 48° 12′ S., and the basins of the Coligue or Bravo river and of the Lower Mayer, below the point already specified, on the west, striking the north-eastern arm of Lago San Martin at the mouth of the Mayer river. From this point it shall follow the medium line of the lake southwards as far as a point opposite the spur which terminates on the southern shore of the lake in long. 72° 47′ W., whence the boundary shall be drawn to the foot of this spur, and ascend the local water-parting to Mount Fitzroy, and thence to the continental water-parting to the north-west of Lago Viedma. Here the boundary is already determined between the two republics.

Region of Last Hope Inlet.—From the point of divergence of the two boundaries claimed by Chile and Argentina respectively in lat. 50° 50′ S., the boundary shall follow the high crests of the Sierra Baguales to the southern spur which leads it to the sources of the Zanja Honda stream. Thence it shall follow that stream until it reaches existing settlements. From this point it shall be carried southwards, having regard, as far as possible, to existing claims, crossing the river Vizcachas and ascending to the northern peak of Mount Cazador (948 metres). It shall then follow the crest-line of the Cerro Cazador southwards, and the southern spur which touches the Guillermo stream in long. 72° 17′ 30″ W. Crossing this stream, it shall ascend the spur which conducts it to the point marked 650 metres on the map. This point is on the Continental water-parting, which the boundary shall follow to its junction with the 52nd parallel of south latitude.

GEOGRAPHICAL DISTRIBUTION OF PLANT-GROUPS IN IRELAND.*

By R. LLOYD PRAEGER.

For the purpose of expressing the horizontal range of flowering plants in Great Britain, H. C. Watson† has employed eight "Types of Distribution," which he has named and defined as follows:—

1. British type—species widely spread through S.M.N. Britain.
2. English type—species chiefly seen in S. or S.M. Britain.
3. Scottish type—species chiefly seen in N. or N.M. Britain.
   Intermediate type—species chiefly seen in Mid-Britain.
4. Highland type—species chiefly seen about the mountains.
5. Germanic type—species chiefly seen in East England.
6. Atlantic type—species chiefly seen in West England.
   Local species, restricted to single or few provinces.

Watson is careful to state that in the use of the names for these types he does not make any suggestion regarding the centre of dispersal or route of migration of the plant-groups which they represent; he uses them simply to express facts of present distribution in Great Britain; Ireland does not come within the scope of his inquiries. I propose, in the first place, to review the distribution in Ireland of Watson's types, and from that to pass on to the consideration of natural Types of Distribution in Ireland as revealed by a study of the flora of that country.

The most convenient way of expressing the facts to be dealt with is by means of a series of statistical maps, constructed according to a uniform plan, in five depths of shading. The units of area employed are the forty county-divisions of

* Abstract of papers recently read before the Royal Irish Academy and the British Association (Belfast Meeting). The illustrations are taken (by permission of the Council) from the *Proceedings* of the R.I. Academy, vol. xxiv., section B, No. 1, where a full discussion of the subject will be found.

† *Cybele Britannica*, i. 43 (1847), iv. 409 (1859); and *Compendium of the Cybele Britannica*, 23 (1868-70).

"Irish Topographical Botany," and the standard used as a list of the Irish flora and its distribution, is taken from the same work, posted up to date. For the construction of the maps, the distribution in the forty divisions of the component species of each group has been tabulated. From the totals thus obtained for the county-divisions, giving the number of plants of the type present in each, the lowest and highest figures are taken, and the intervening space divided into five equal portions. The forty totals are grouped according to these five portions, and the map shaded accordingly in the order:—

(1) white, (2) ☰, (3) ☰☰☰☰, (4) ⁞⁞⁞⁞, (5) black.

1. British Type: "Species widely spread through S.M.N. Britain."—To this type belongs the mass of our common plants. From the definition of the type we should expect to find plants of this group largely represented and widely spread in Ireland, and this expectation is verified.

Of the distribution of the 377 typical British type plants in Ireland, I have made a somewhat minute analysis, to discover if the varying conditions of soil and climate produce any increase or diminution in their numbers in north or south, east or west. There is no indication of the kind.

2. English Type: "Species chiefly seen in S. or S.M. Britain."—These are the southern plants of Great Britain, having their headquarters in the south of England. They are largely lowland species favouring light soils.

Of plants of pure English type, 135 are included, according to our standard list, in the Irish flora. But of these, no less than 44, or 33 per cent., are reckoned in Ireland as possibly, probably, or certainly introduced. Here, in fact, we have come upon the home of the large section of our vegetation which owes its presence in the country to the operations of man—the weeds of cultivation, and light-soil plants. Leaving these out of account, the distribution in Ireland of "English" plants works out as in Fig. 1.

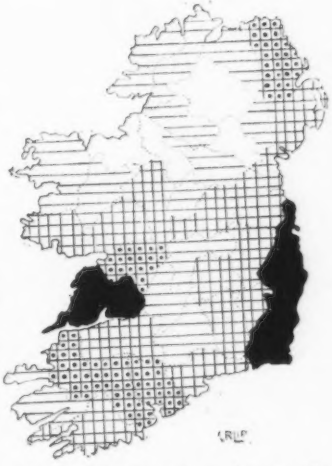


FIG. 1.—DISTRIBUTION OF "ENGLISH" PLANTS.

This map shows clearly how the English type plants reach their maximum along the east coast in Dublin, Wicklow, and Wexford, as we should expect them to do from considerations of position, soil, and climate. Their great abundance in Clare is a remarkable point, to which we shall presently return. For the rest, excepting their frequency in Antrim, they decrease from S.E. to N.W.

3. Scottish Type: "Species chiefly seen in N. or N.M. Britain."—This type is the opposite of the last. With headquarters well up in Scotland, the species range southward in diminishing numbers. They are the northern plants of Britain. This is a purely native group; not one of them is under any suspicion of introduction. Most of them are plants of thoroughly wild ground—hills, heaths, glens, lakes, and bogs.

Constructing our map, we get Fig. 2.

The result is striking. The Scottish type plants are concentrated in the north, as we should expect. Thence they range down the coast on either side:

but while on the east they greatly diminish south of Co. Down, on the west coast they maintain their sway as far south as Clare, or even North Kerry.

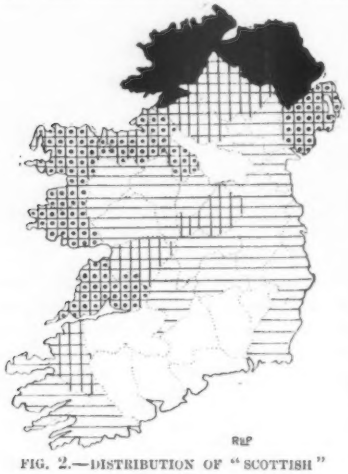


FIG. 2.—DISTRIBUTION OF "SCOTTISH" PLANTS.

4. HIGHLAND TYPE: "Species chiefly seen about the mountains."—As H. C. Watson points out, the more characteristic members of this group might be better called Arctic type, as they consist of high northern species, brought into our latitudes by the elevation of the land into mountains. This group occupies the northern end of the series of four latitudinal types—English, Intermediate (a small and indefinite group), Scottish, Highland. Its headquarters are on the high Scotch mountains and in the extreme north of that country. With the vertical distribution of the species the present paper is not concerned; but some interesting points become apparent from the mapping of their horizontal range (Fig. 3).

Being essentially a mountain group, it is desirable to contrast their distribution with that of high land in Ireland—say of over 2000 feet elevation (Fig. 4).

In area of high ground, whether the 1000-foot or 2000-foot contour line be

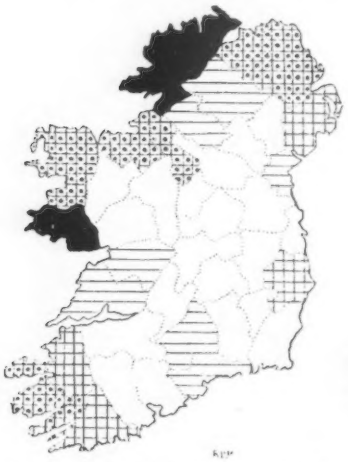


FIG. 3.—DISTRIBUTION OF "HIGHLAND" PLANTS.

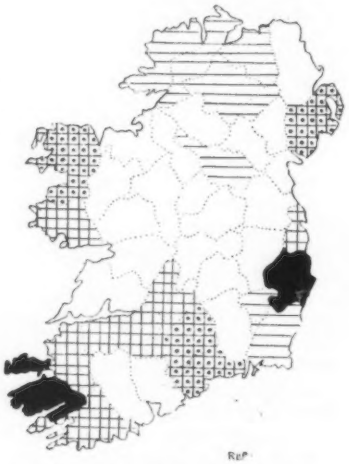


FIG. 4.—DISTRIBUTION OF LAND OVER 2000 FEET.

taken, Wicklow and South Kerry far outstrip any other portion of the country: yet both fall below the maximum of alpine plants, which is carried off by West Galway, and the two divisions of Donegal. The distribution of highland ground

is, in fact, no criterion of the distribution of the highland flora. The amount of high ground in western Ireland (Kerry to Donegal inclusive) is about the same as that in eastern Ireland; but the collective highland flora of the western half is double that of the eastern. If we want to get an analogue of the distribution of the alpine flora we turn to the Scottish type map, and at once see many points of resemblance.

Those "Highland" plants which occur in the east, as on the Mourne and Wicklow mountain ranges, are usually truly alpine in habitat; in the west a change of conditions is clearly shown by the frequent descent of alpines to sea-level, and by the ascent of maritime plants to high elevations (such as *Cochlearia officinalis*, *Silene maritima*, *Armeria maritima*, *Plantago maritima*) which are absent on the eastern mountains.

5. GERMANIC TYPE: "Plants chiefly seen in East England."—This is a special group of English type plants, segregated and separately classed on account of their masked aggregation towards the south-east. As Watson points out, the Cretaceous deposits lie almost exclusively in the eastern and south-eastern provinces of England, so that the "chalk plants" fall within this type.

Being the furthest removed from Ireland as regards not only actual distance, but soil and climate, it is to be expected that this should be the type least numerously represented in this country, and such is the case. Out of one hundred and two "Germanic" plants in England, only thirteen are enumerated in the Irish flora, and four of these cannot be reckoned in the certainly indigenous list. The distribution of the native members of the group works out as in Fig. 5.

This result is significant, even though, when dealing with the distribution of so small a number of plants, it is unwise to lay too great emphasis on present results. The fact is that, as a group, the Germanic plants have no place in the Irish flora; such stragglers as have found their way here have a distinctly *limestone* range.

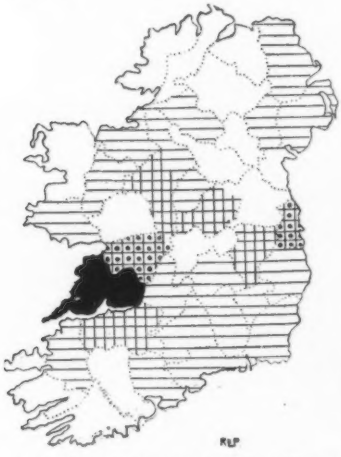


FIG. 5.—DISTRIBUTION OF "GERMANIC" PLANTS.

FIG. 6.—DISTRIBUTION OF "ATLANTIC" PLANTS.

6. ATLANTIC TYPE: "Species chiefly seen in West England."—This group has its headquarters in the south-west of England, and is in this way related to the

"Hibernian" and "Lusitanian" groups of Ireland, since it includes the remnants of the old southern flora that flourished on the lost south-western shore-line of the British Isles.

Our map works out very prettily. The group is seen to be essentially coastal—partly on account of the plentiful sprinkling of maritime species, partly because the remainder are largely plants of the rough country which often accompanies the older rocks; such country as is found in the home of the group in Devon, Cornwall, and Wales, and in Ireland round a great portion of the seaboard. The group also shows an increase southward, and attains its full luxuriance round the shores of the southern half of Ireland.

Before proceeding to briefly sum up the features brought out by the foregoing eries of maps, it will be well to consider one important factor in plant-distribution. Apart from climate, the most potent influence affecting the flora is undoubtedly soil, and it is the presence or absence of lime in soils that most affects the vegetation which they support. Ireland consists, roughly speaking, of a great plain of Carboniferous limestone occupying the centre, with more elevated and broken ground formed of non-calcareous rocks around the margin. The actual distribution of limestone is shown in black on the following map (Fig. 7). Let us compare this with the distribution of lime-loving and lime-avoiding plants.

FIG. 7.—ACTUAL DISTRIBUTION OF CARBONIFEROUS LIMESTONE.

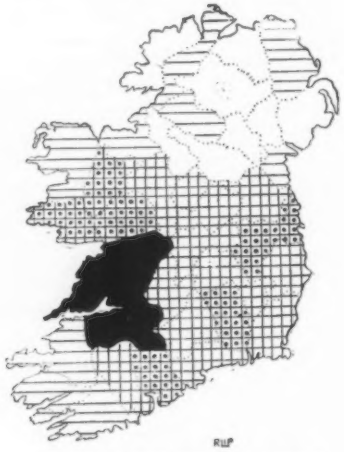


FIG. 8.—DISTRIBUTION OF CALCICOLE PLANTS.

The result is somewhat unexpected. The calcicole group has its headquarters, not in the Limestone Plain, but in the west, reaching its maximum in Clare, South-East Galway, and Limerick. The reason for the great development of the calcicole group in the west is not far to seek; it lies in the occurrence of bare limestone pavements in the Burren area, in Limerick, and around the great lakes of Corrib and Mask. It is the presence of live limestone rock over large areas that produces the calcicole flora in its full development. The tough limestone drift which covers the rock over the greater portion of the Central Plain and eastern counties may, as a matter of fact, have all the lime washed out of its surface layers, and yield a non-calcareous soil

To turn to the calcifuge group. The plants which show a preference for a non-calcareous soil are more numerous than those which prefer lime. It will be noted (Fig. 9) that calcifuge plants are more abundantly spread than calcicole. The reason is clearly to be seen in the fact that non-calcareous soils are to be found in limestone areas, both on account of the washing-out process referred to, and by reason of accumulation of vegetable matter, in woods, and much more in bogs, which are largely developed in the Irish limestone districts. On the other hand, no natural process is at work in this country producing a calcareous soil in districts devoid of limestone, except on coastal sands, where shelly accumulations may have a distinct effect on the flora.

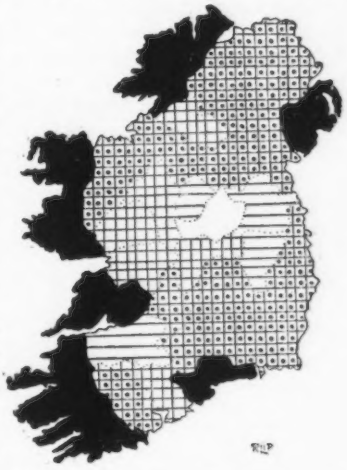


FIG. 9.—DISTRIBUTION OF CALCIFUGE PLANTS.

Comparing generally the series of maps showing the range in Ireland of the "types" of Great Britain, it will be seen that we have really three topographical groups to deal with—

(1) *English and Germanic*, the latter a peculiar and intensified section of the former. A southern group, often light-soil and often calcicole in their proclivities. The Germanic group represent the xerophile and thermophile element in the flora of England, and is congregated where a comparatively continental climate produces hot and dry summers. In Ireland these groups are concentrated along the east and south-east coasts, where position, soil, and climate apparently account for their predominance; and in the Clare district, where the warm limestone pavements coupled with a mild climate probably form the attraction.

(2) *Scottish and Highland.*—These are the northern plants, the latter an intensified group of the former. In Ireland they are concentrated in the north, spreading somewhat abundantly down the western coast, much more sparsely along the eastern. It should be noted that the distribution in England and Wales of these plants offers many points of resemblance to their Irish range, though the species extend somewhat further southward in the larger island. As in Ireland, the group spreads far down the west coast of England, much less so down the eastern, so that, on a rough examination, South Wales appears to contain as many "Scottish" plants as the Trent province. Physical conditions will suggest themselves in explanation of this in a manner not applicable to Ireland, where the problem is more difficult of solution. A line drawn north-eastward from the Bristol channel to the Wash will cut off, on the northward, most of these plants; and this line would appear to correspond well with one in Ireland drawn from the Shannon mouth to Dundalk bay.

(3) *Atlantic.*—In England south-western and including a considerable number of maritime plants. This is the hygrophile element of the English flora, composed of plants which prefer the equable temperature and abundant moisture that pertain to an insular climate. In Ireland the group is rather southern, distributed in fair proportion round the southern half of the littoral, but many of the species occur round the greater part of the Irish coast.

Glancing at the maps showing the distribution of calcicole and calcifuge species, it will be seen that, while the range of the "Scottish," "Highland," and "Atlantic" plants corresponds broadly with that of the calcifuge flora, the distribution of "English" and "Germanic" species offers many points of resemblance to that of the calcicole group, which facts we should expect to be apparent when we consider the petrological conditions prevailing in the homes of Watson's various "types."

So far as I can gather, without an elaborate study of the distribution of the flora of Great Britain as known at present (which would be outside the scope of the present paper), there is a greater overlap in northern and southern forms in England than is the case with Ireland. If we construct isophytic lines to represent the limit of the main body of the "Scottish" and "English" floras respectively in Great Britain and in Ireland, they run somewhat like this:—

FIG. 10.—ISOPHYTIC LINES IN THE BRITISH FLORA.—AA, NORTHERN LIMIT OF THE "ENGLISH" FLORA; BB, SOUTHERN LIMIT OF THE "SCOTTISH" FLORA.

To come now to the second portion of my subject—the question of natural geographic plant-groups in the Irish flora. Following on Watson's lines, an essay was made to group the native species according to their present horizontal range, and without reference (in the first instance) to the environmental or other cause of such distribution. For this purpose, a set of maps was employed representing the whole Irish flora, each map showing, by means of a uniform wash of colour, the range of one species, the data used being those given in "Irish Topographical Botany," brought up to date on these maps. Divisions in which any plant was considered as probably or certainly introduced were left uncoloured. The set of over eleven hundred maps was then sorted by eye according to the distribution of the colour on each. In this way, by making the process as mechanical as possible, I hoped to determine the natural grouping of the plants, and to eliminate theoretical considerations. The groups thus obtained were then critically examined, and the claim of each member to belong to it considered. This involved questions of

relative frequency throughout the range, and considerations relating to possible introduction in certain divisions.

The grouping of the maps established in the first place two classes: (A) plants which show no aggregation in any portion of the country; and (B) plants which show an aggregation or diminution in some portion of the country. Class A corresponds with Watson's British type, and consists mainly, but by no means exclusively, of the same species. It need not detain us at present, and we turn to a consideration of the distribution of those plants which show an aggregation in some part of the country.

As regards Class B, it is to be remembered that, as compared with Great Britain, Ireland is small, with a more restricted range both in latitude and in longitude, and in altitude as well. It is also of more even shape, being roughly elliptical in outline, and possesses less variety of surface and climate. It is not surprising, therefore, that the flora of its various portions displays a reduced diversity; in other words, that the number of species of strongly marked local range is not large. Nevertheless, some definite features of distribution came out clearly as the maps were studied. The first strong character displayed is a tendency towards a central or marginal distribution, a peculiarity not found to any marked degree in the flora of Great Britain, and resulting from the physical features of the country. The non-calcareous rocks and the mountain groups lie around the edge of the country, and here is concentrated the flora pertaining to such conditions; while the low-lying limestone plain, with its numerous bogs, marshes, and lakes, is the headquarters of a different set of species. By referring a plant to the "Central" type of distribution, then, we signify that it is found chiefly in the Central Plain. While plants of this type often extend to the margin of the island in the east and west, they show a marked restriction of range towards the north and south.

The Central type of distribution may be defined as being limited by a line joining the Shannon mouth with Waterford on the south, and a line joining Sligo bay with Dundalk bay on the north, while in its most characteristic form it does not touch either the eastern or western margin of the island. The circle on Fig. 11 approximately defines its ideal boundary.

The Marginal type, which is, generally speaking, the converse of this, hardly requires definition, as its name is sufficiently descriptive. The plants which belong to it are characterized by a tolerably even though frequently discontinuous range through those divisions which lie around the margin of the island, and by an avoiding of the Limestone plain. The negative character of avoidance of the Central plain is the most striking feature of this type of distribution; and the ring which marks the range of the constituent species frequently thickens considerably in the north and south, where the coast-line lies far from the edge of the plain.

A number of the rarer and more interesting plants of Ireland are more or less marginal in distribution (being rare in the Central Plain), but are restricted to limited areas; while many others show a general increase towards the north, south, east, or west of the island. As regards these, the strongest phytological boundary which developed itself is one which corresponds with the curves evolved from a consideration of the range in Ireland of the northern and southern plants of Great Britain (see Fig. 10); and this boundary can be best localized by drawing a line from Galway bay on the west to Dundalk bay on the east. The need of a dividing line between eastern and western plants also became clear; and the most natural boundary appeared to be a line passing through the cities of Londonderry and Cork—a division which coincides with the partition into eastern and western already employed in "Irish Topographical Botany."

The central circle and these two intersecting lines, then, define six types of distribution which, I believe, are founded on the actual range of plants in the country. The names most conveniently employed for the "types" will be—

2. Central.
3. Marginal.
4. Ultonian.
5. Mumonian.
6. Lagenian.
7. Connacian.

the last four being named after the four provinces of Ireland, in which each type respectively reaches its maximum.

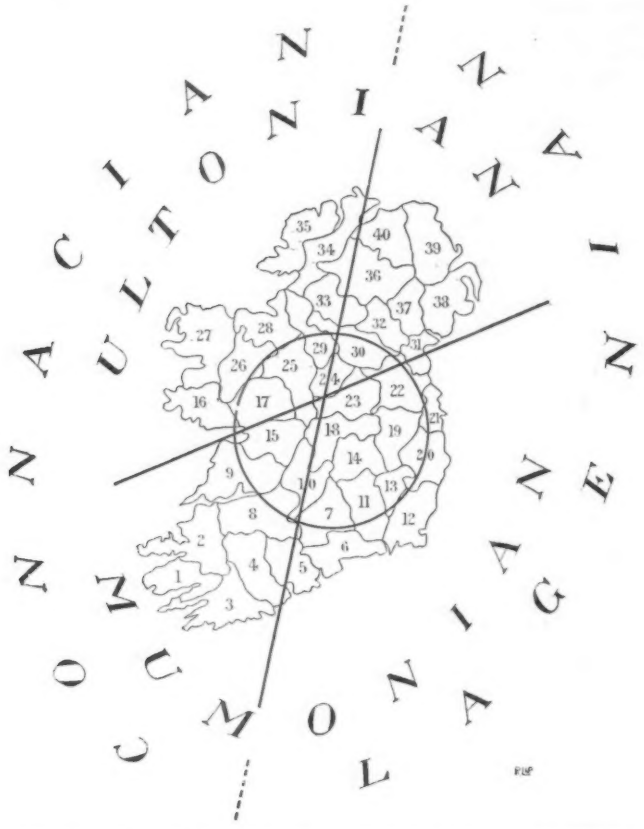


FIG. 11.—BOUNDARIES OF THE AREAS OF THE IRISH TYPES OF DISTRIBUTION.

Lists of the species belonging to each of these types of distribution, and analyses of these lists according to habitat, type in Great Britain, etc., will be found in the paper already referred to. In this place I merely illustrate the range of one typical member of each of the six groups:—

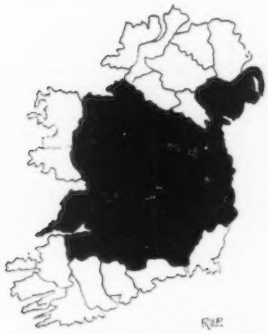


FIG. 12.—ANDROMEDA POLIFOLIA. CENTRAL TYPE.

FIG. 13.—HYPERICUM ELODES. MARGINAL TYPE.

FIG. 14.—CIRCÆA ALPINA. ULTONIAN TYPE.

FIG. 15.—RANUNCULUS LENORMANDI. MUMONIAN TYPE.

FIG. 16.—SCILLA VERNA. LAGENIAN TYPE.

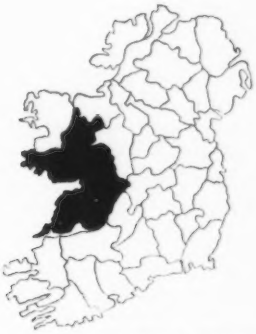


FIG. 17.—HABENARIA INTACTA. CONNACIAN TYPE.

Lastly, as to the distribution of plants which are probably or certainly introduced in Ireland. The more successful aliens, other than those of general distribution, are grouped round the margin of the island, especially in the south and east. They reach their minimum in the centre, north, and west. Their distribution, in fact, coincides with that of the indigenous "English" plants (Fig. 1), to which type belong, as will be seen from the analysis appended to the list, sixteen out of twenty-six classed by Watson. The Mumonian or Lagenian range of the aliens is of interest, for there can be no doubt that it is the result of conditions of climate and soil. In support of this view, one remarkable instance may be cited. Clover seed, imported from England, is sown widely in Ireland; official information supplied to me is to the effect that no more clover is sown in the south and east than in other parts of the country. With the clover come the seeds of the parasite *Orobanche minor*, a plant of English type, not a native of Ireland, and unknown therein until some forty years ago. The plant is now an established and spreading colonist, and its present range coincides in a striking degree with that of the group to which it belongs—the light-soil English type plants. In the central portions of its range—Wexford particularly—it is now abundant and permanent. This further emphasizes the floral peculiarities of the south-eastern portion of Ireland, which has in my paper already been demonstrated both from the presence and absence therein of certain groups of species. The great Leinster anticline is an important factor in Irish plant distribution, and a phytological boundary of marked character is formed by the line where its uplands sink into the Central Plain, and by the prolongation of that line northwards and southwards.

FIG. 18.—OROBANCHE MINOR.

Of the seven types of distribution proposed in this paper, five have their analogues in the types which Watson instituted for Great Britain. In both series we have a General type, and a Northern, Southern, Eastern, and Western type. While the General, Northern, and Southern in a wide sense correspond in their composition, the Eastern group of Ireland is seen to be essentially southern in Britain, while the Eastern group of Britain is practically absent from Ireland; nevertheless the two eastern groups correspond in character, representing in each case the nucleus of the thermophile and xerophile element of the flora—n England a much more intensified element than in Ireland. The Western plants of the two islands also exhibit a wide diversity in range, those of Britain being Southern and Marginal in Ireland, while those of Ireland are not to any extent Western in Great Britain, and include besides a number of species absent from the sister island. But here again the two have affinities, both being hygrophile and frigofuge in character. The two remaining Irish types, the Central and Marginal, have no analogues in Great Britain. The former consists largely of "English" species, the latter chiefly of "British" plants which do not penetrate into the Limestone Plain.

So much for the facts. The causes which lead or have led to the distribution of the flora as we now find it are difficult to determine.

The effect produced by the distribution of lime, and of open light soils, is fairly clear; but climatic effects are not so easily determined. As regards temperature, some of the characteristic plants of Connacian type are without doubt frigofuge—

in other words, their chief need in our climate is a sufficiently high winter temperature; and in Fig. 19, which shows the isotherms of the coldest month of the year in Ireland (January), parallels between isophytic and isothermal lines may easily

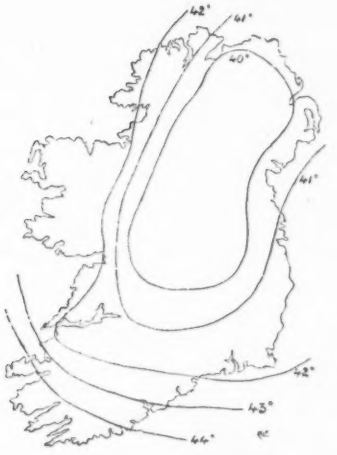


FIG. 19.—JANUARY ISOTHERMS.

FIG. 20.—JULY ISOTHERMS.

be drawn, from among the plants of the south and west. Fig. 20 likewise, showing the isotherms of the warmest month (July), suggests that a number of the south-eastern species may be thermophiles—plants for which the most pressing need is a high summer temperature for the ripening of fruit. Questions of rainfall probably effect little the distribution of plants in Ireland, since (Fig. 21) there is everywhere a sufficiency. But the limit of the Connacian type (Fig. 11) will be seen to correspond with that of the wet west-of-the-Shannon district of Ireland, while the driest area is included in that which marks the range of the Lagenian and most of the "English" type species. There is even a dry area around Galway bay which no doubt helps to produce the remarkable aggregation of "English" and "Germanic" species in north Clare. But the facts are not yet brought together, nor the observations made, which will enable us to determine how far the present distribution of plants is effected by climatic causes. Nor is this the only direction in which work is required. We can never hope to understand our phyto-geography till its problems have been attacked by the historical method. Yet the history of the Irish flora is still an absolutely unworked field.

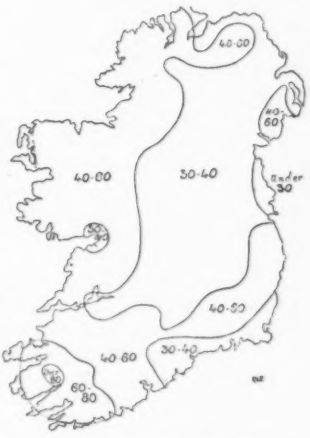


FIG. 21.—ANNUAL RAINFALL.

The records lie buried below our peat bogs and superficial deposits, and their elucidation will furnish evidence of the highest importance. No branch of Irish botany has more pressing claims on the field botanist than this.

REVIEWS.

EUROPE.

The English Lakes.

'The English Lakes.' By F. G. Brabant, M.A. Illustrated by Edmund H. New. London: Methuen. 1902.

The writing of a new guide to the English Lakes, when the task has been already performed with so near an approach to perfection as it has by Mr. Baddeley, is a somewhat bold undertaking, and one that would hardly be justified but for the somewhat different point of view adopted, and the fact that the book is an item that could hardly be omitted from the series of "Little Guides" under course of publication by Messrs. Methuen. Mr. Brabant has certainly carried out his difficult task well, though a perhaps unavoidable similarity is often to be observed between his treatment of his subject and that of his predecessor. From one point of view he possesses the advantage, for the dainty "get-up" of the volumes of the series, and the charming illustrations supplied by Mr. New, place the work on a somewhat different footing from the ordinary guide-book, which is intended for practical use rather than pleasing appearance. He has also been able to adopt a somewhat more descriptive style than is possible in the matter-of-fact directions of a guide-book pure and simple, while the arrangement is still practical and systematic. The opening section gives a concise view of the physical features, industries, history, etc., of the district as a whole, the orographical features being treated, no doubt wisely in a book of the kind, in their present form rather than in relation to geological history. Thus the Scafell group is taken as the centre of a western system from which arms radiate in all directions, while the Helvellyn and Skiddaw groups form other units. From a purely morphological point of view it seems unfortunate that the Langdale Pikes should be placed with the second group, as they so evidently belong to one of the radiating arms of the first, and the Thirlmere and Grasmere valleys form together so marked a natural dividing-line. Mr. Brabant shows an intimate acquaintance with the district, though hardly possessing the exhaustive knowledge of its every nook and corner shown by Mr. Baddeley. His judgment may occasionally be thought at fault, as when he describes the upper part of the Grasmere-Borrowdale route by Greenup Edge as "somewhat dull and tiresome." The immediate surroundings are no doubt somewhat devoid of interest, but the Edge commands one of the finest panoramas of fell-summits that are to be seen in the district. The maps, by Bartholomew, are identical with those in Baddeley, apart from the absence of gradations of colouring and their different subdivision into sections—in which they certainly do not possess the advantage. The illustrations, as already said, are perfectly charming, and possess the unusual merit, for drawings, of representing the originals with absolute fidelity of outline.

The Hebrides.

'The Outer Isles.' By A. Goodrich-Freer. Westminster: Constable. 1902.

This work, which is based on visits dating from 1894 onwards, deals rather with the people than with the physical character of the Hebrides, being concerned chiefly with questions of history, folk-lore, and the like. More nearly related to geography is the information on the industries and general manner of life of the people, with whom the author mixed freely, and whom he describes with sympathetic interest. There is a chapter on the Norsemen in the Hebrides, with an account of the remains dating from the Viking period, and the Norse element still traceable in the place-names. The book will certainly help to make the islands better known to the general public, though the picture of the prevailing ignorance of the Hebrides is perhaps somewhat overdrawn by the author.

Spain.

'The Land of the Dons.' By Leonard Williams. London: Cassell. 1902.

This work stands on a distinctly higher level than the ephemeral productions of tourists, who, after a visit, perhaps, of a few weeks, hasten to pose as authorities on a country with which they have acquired but a surface acquaintanceship. Its author, late *Times* correspondent at Madrid, has lived in the country a number of years and been a serious student of Spain and the Spaniards, so that he is able to speak from intimate knowledge of both. By far the larger part of the book relates to the people, of whose inner life and past history Mr. Williams shows a thorough understanding. From our particular point of view it might be wished that the author had devoted more space to a descriptive account of the country as well, for the solitary chapter devoted to its surface features shows that he is quite competent to speak of the geographical aspects of Spain, while works dealing with these from a general, and not too severely scientific, point of view, have not been too common of late years. Mr. Williams' remarks on the mountain ranges of Spain and their respective characteristics are of especial interest. "To one who is familiar with the country," we are told, "these mountains bear an unmistakable individualism; so much so, that were he to be conveyed blindfold to every quarter of the country in turn, and the bandage to be stripped at intervals from his eyes, the merest glance would tell him where he was, and what sierra he was confronting." In remarking on the absence of wood over the larger part of the surface, Mr. Williams shows himself a believer in a once much more extensive forest-covering, quoting an old record which speaks of a forest even in the neighbourhood of Madrid; but he will hardly be followed by those who point to the general climatic conditions of this part of the world as evidence that the land, as a whole, must always have been poorly supplied with moisture, and therefore with forest growth. For the absence of trees, he finds a compensation in the noble freedom which characterizes a typical Spanish landscape. "You may strike a line due north or south from Avila to Burgos, or Madrid to the Sierra Morena, not a soul will ask your business, never a wall or fence arrest you." The manners and customs of the people are fully described, and the past, present, and probable future of the country is in turn discussed in the three concluding chapters. Mr. Williams shows a genuine sympathy with the Spanish people, and has an especial liking for the Basques, whom he describes as the noblest-hearted and most obliging fellows in the world, while their country is "beautiful beyond description." He writes in a terse and forcible style, and has the valuable gift of presenting a complete and vivid picture in a few pregnant sentences.

ASIA.

The Hissar Mountains.

Mountainous Bokhara. Results of Three Summer Journeys in Central Asia in the years 1896, 1897, and 1899.' V. J. Lipski. Part I. The Hissar Expedition, 1896. St. Petersburg, 1902. [In Russian.]

In the course of the three summers M. Lipski spent in Central Asia he explored the Hissar mountains, the Peter the Great range in the Alai, the Darwaz, Mazar, and smaller groups. The volume he has lately published deals with the Hissar range, a western offshoot of the Alai-tagh, which has a length of about 200 miles, and terminates on the west with the Khazret-Sultan group. Its altitude is very considerable, most of the passes lying at a height of 12,000 feet and over, while the summits rise 1000 to 3000 feet above them. Nevertheless, they are not covered to any great extent with snow. The most extensive snowfields lie on the northern flank, where, also, almost all the glaciers are to be found. The absence of forests is striking. Trees grow only along the rivers, and there only in small clumps. The herbage also is poor. This is a result of the climate, which in general is very dry, though in the year 1896 the quantity of precipitation—rain and snow—was unusually great, causing floods which swept away the bridges over the river Tupalang, and completely destroyed the village of Sariju. M. Lipski travelled chiefly along the southern side of the Hissar mountains, which sends out lofty spurs towards the south, extending his journey eastwards into Karategin. Assisted by his companion, Captain Barshchevski, he made large botanical (10,000 specimens), zoological, and geological collections, and examined several glaciers. These terminate at a great height, none descending below 10,000 feet. They are generally covered with snow, and their extremities are buried under detritus. Vast accumulations of morainal *débris* show that the glaciers are receding, and traces of glaciers were found where none exists at the present time. As regards the geology, it seems that the core of the range consists of granite, and that limestones, diabase, and mica-schist are widely distributed. Among the inhabitants of the Hissar mountains, the most remarkable are the people of the Yagnop valley, in Russian territory, who speak a language of their own, and have a vague tradition that their forefathers came from Kashmir.

A map, tables of the meteorological observations taken, and a synopsis of the collections, are much to be desired. Probably they are reserved for the conclusion of the work. The illustrations of scenery and natives are excellent.

China.

'Travels in North and Central China.' By John Grant Birch. London: Hurst & Blackett. 1902.

The author of this narrative was drowned in the Hwang-ho by the upsetting of a raft, when attempting the descent of the river in company with Captain Watts Jones in the early days of the Boxer troubles. His diary, which is now printed in a somewhat compressed and modified form, relates to various journeys in the Chinese empire carried out in 1899–1900, with a short interval, during which he returned to this country. The first two journeys led from Peking to Kalgan and Mukden respectively, including a visit to the Ming tombs on the return from the first, and to the mausoleum of the Manchu kings, a little to the north of Mukden, on the second. On his return from England Mr. Birch undertook a more extensive journey in western China, ascending the Yang-tse to Wan-hsien above the gorges, and then starting overland through Suchwan by a route somewhat north of Mrs.

Bishop's. The province was traversed in various directions, both north and south of the capital, which was twice visited; but the most interesting journey was that from Cheng-tu north, across the highlands which separate the basins of the Yang-tse and Hwang-ho, which have still been traversed by but a few Europeans. Unfortunately the diary of this section of the journey has not been saved, and the only information available is a letter written by Mr. Birch after arriving at Lan-chau, which gives the merest outline of the main course of the journey.

The book is pleasantly written, and although a large part of it deals with fairly well-known country, it contains many interesting observations on the character and state of the country traversed, the work of the missionaries, both Catholic and Protestant, with whom the author came in contact, and the attitude of the Chinese towards European enterprise. The very brief editorial notes say nothing as to the motives which prompted the journey, and the reader is left to gather from the narrative that the writer was interested in the question of railway enterprise in western China.

From Cheng-tu, he set out north in company with Captain Watts-Jones, who, after the mishap on the Hwang-ho, was so barbarously murdered at Kwei-hwa-cheng. The route followed was in part entirely new, and led through country really belonging to Tibet, though marked as part of China in most maps. No trouble was experienced from the Mantse tribes, who have a wholesome respect for foreign firearms. Some magnificent scenery was traversed, two passes nearly 14,000 feet above sea-level being crossed, while the party was twice overtaken by snow. The alpine and other flowers, including many English kinds, were very beautiful at these high altitudes. At one of the passes Mr. Birch considers that he must have been very near the headwaters of the Ta-tung, but exploration to the west is necessary before the hydrographical system can be fully elucidated, as some of the water flowing north from the passes turns back on the plateau itself. The position of Ta-chau on the map is said to be incorrect.

It is deeply to be regretted that Mr. Birch did not survive to give a full narrative of this important journey, though his death in the Hwang-ho saved him from the worse fate which befel his companion.

The Himalayas and Persia.

'Sport and Politics under an Eastern Sky.' By the Earl of Ronaldshay. London: Blackwood. 1902.

This book is composed of two separate parts; the first dealing with sporting adventures in the Western Himalayas, the second with the author's journey from India through Eastern Persia by the newly opened trade route. Lord Ronaldshay's mountain wanderings led him through some of the grandest scenery of the snowy ranges of Kashmir (among other points, to the northern foot of Nanga Parbat, or Deomir—"mountain of the gods"), as well as across the bleak, elevated plateaus of Ladak and Baltistan; and if, in the sporting incidents which form a large part of the narrative, our sympathies are apt to be on the side of the author's victims in their somewhat unequal contest against modern weapons of precision, the picture is relieved by his keen appreciation of the wild sublimity of the scenes in which he moved, which is not shown to a like extent by every sportsman. Of the second and larger part of the book it is unnecessary to speak at length, as the journey has so recently been described in the *Journal*, while the fact that Eastern Persia, in its past and present relations, has been so recently and admirably described by Major Sykes, has of necessity somewhat detracted from the novelty of much that Lord Ronaldshay could tell us as the result of his journey. His

work indeed makes no pretensions to be much more than a "wanderer's diary." He devotes some space to a description of the country and people of Sistan, on the importance of which he insists, not merely for its great fertility, but on account of its position relatively to the surrounding countries; and bears full testimony to the influence with the people which Major Sykes has acquired by his *bonhomie* and tact. With respect to much of the other districts traversed, the impression conveyed by the narrative is one of dreary monotony and desolation, leading one to the conclusion that, in themselves at least, they can never afford an adequate occasion for international rivalry. Of Birjand, however, and its apparently increasing trade, a somewhat brighter picture is drawn.

Nepal.

'Durch Indien ins Verschlossene Land Nepal.' By Dr. K. Boeck. Leipzig: F. Hirt & Son. 1903.

The author, who has visited India frequently in the course of the last twelve years, describes his book as a series of sketches from Ceylon to Nepal. In these literary sketches and the numerous photographs that accompany them, the first place is given to the native population and its daily life; architecture, particularly in the strange temples of the south, Madura and Seringham, is also well illustrated. Less attention has been paid to the better-known Mohammedan architecture of the north. Dr. Boeck was fortunate in obtaining leave, generally restricted to the Resident's guests, to visit Katmandu and its environs, and his photographs of the local architecture are numerous and interesting. From the Kakani heights, some few miles north of Katmandu, previously visited by H. Schlagintweit, he obtained a view of the snow mountains visible to the east, amongst which he was pointed out "Gaurisankar-Everest."

Syria and Palestine.

'The Semitic Series.—The Early History of Syria and Palestine.' By Lewis Bayles Paton. London: Nimmo. 1902.

The general reader is here presented with a clear outline of the history of the Western Semites from the earliest times down to the establishment of the Persian empire, so far as it can be pieced together from the narratives of the Bible and other ancient sources, and from the results of the most recent explorations both in Syria and Palestine, and in the neighbouring Eastern lands with which those countries were brought so much into contact. The story of Israel and the Phœnicians will be told more fully in other volumes of the series, but the present work gives a valuable insight into the general movements of the Semitic peoples in ancient times.

AFRICA.

East Africa.

'Mitteilungen über Meine Reise nach Aequatorial-Ost-Afrika und Uganda 1896–1897.' Von Dr. Max Schoeller. Vols. i. and iii. Maps. Berlin: Reimer. 1901.

The journey of which the results are given in these volumes was carried out some five years ago, and was described in some detail at the time in the *Journal*. In his preface the author explains the reasons which have delayed its appearance, and which have even now led to some curtailment of the original plan. Of the three volumes which are to constitute the complete work, only the first and third

(which consists entirely of maps) have yet been received, and much of the most valuable material is being reserved for vol. ii. The work is produced in a sumptuous style, and, in spite of its somewhat late appearance, is to be welcomed as a valuable addition to East African literature. The greater part is taken up with the narrative of the journey so far as it relates to German East Africa, while the larger section of the route, which led through British East Africa to the Victorian Nyanza and Uganda, will be dealt with in the second volume. Though not, of course, of the nature of a systematic treatise, this narrative section abounds with instructive remarks on the various branches of science which engaged the attention of the author, especially the structural geology, and affords yet another proof of the power of observation so generally characteristic of German travellers. We find, *e.g.*, full discussions of the great fault systems which traverse East Africa, both in the Pangani region—where the original rift-character is still traceable, though modified by subsequent river-erosion—and in that of the "Natron" lake, a careful comparison being also drawn between the two regions. Economic questions are also touched upon, especially with regard to Usambara, the possibilities of which the author is disposed to rate highly. A zoological discovery was that of the existence of the striped hyæna in German East Africa, which had not been proved before; while a striking picture (recalling those of Sir Harry Johnston) is drawn of the bird-life of the Olgeju lagoon, the central of the three basins into which the "Natron" lake is divided.

The text of the first volume concludes (apart from a section devoted solely to sport) with a very brief summary of the scientific results under the head of cartography, geology, botany and zoology, and ethnology. The route-map, which was the work of Herr Kaiser, is reproduced in vol. iii. in a number of sheets, on, perhaps, an unnecessarily large scale, for it depends solely on the work of the expedition, no other maps being utilized. It is based on careful compass surveys, controlled by bearings to prominent peaks; but whether, in cases of divergence from previous maps, which are not unfrequent, greater reliance is always to be placed in the newer work than on the old, is not easily decided. An extensive series of altitudes, determined by aneroid observations, is given, and these results also differ considerably from those of other travellers. The fact that several instruments were used, so that one checked another, gives some weight to the results, but these do not seem to have been controlled by simultaneous observations at sea-level. A meteorological record was also kept during the journey. In his suggestive sketch of the geological history of East Africa, Dr. Schoeller holds to the view that a land connection with India and South America was maintained through Jurassic times, owing to the similarities observable in the littoral forms of Mollusca dating from that time. Attention must lastly be drawn to the fine series of photographs of native types, though the ethnological remarks are reserved for the second volume.

French Congo.

Émile Gentil, 'La Chute de l'Empire de Rabah.' Paris: Hachette. 1902.

A stirring chapter in the history of the partition of Africa is supplied by this volume, which deals in a concise yet comprehensive manner with the latter stages of the French advance from the Atlantic coast to the shores of Lake Chad. No one man has played a more important part in that advance than M. Gentil, who, whatever may be the future of the territory, will deserve to be remembered, side by side with his predecessor De Brazza, as one of the chief instruments in the realization of the French dream of territorial extension in Western Equatorial

Africa. Even before 1895, when he started on his first important mission to the far north, his thoughts had, during several years' service in the colony, been turned with longing towards the great lake of the Central Sudan, but it was only in the year mentioned that his opportunity came, by promptly seizing which he soon acquired a foremost place among French African pioneers. The present narrative starts from the expedition of 1895–98—which resulted, as is well known, in the placing of the first steamer on the waters of the Shari and the successful navigation of that river to Lake Chad—and recounts the various stages in the story of the French advance, until the last obstacle was removed by the defeat and death of Rabah. M. Gentil's principal attention is naturally directed to the events which are the theme of his book, and the geographical information conveyed is merely incidental to the course of the story. Something is, however, to be learnt of the hydrographical system of the Shari, which throughout played so important a part as a highway to Lake Chad, as well as of the various tribes which inhabit the country and the native politics of the Central Sudan. The fear inspired by Rabah in the peoples he oppressed is frequently insisted on, and there is no doubt that by overthrowing his arbitrary power, M. Gentil and his coadjutors advanced the prospects of civilization in this region. The direct relations maintained between the adventurer and the Mahdists was shown by the capture of two standards sent by Mohamed Achmet to the usurper of Bornu, as symbols of suzerainty. Some light is thrown also upon the position of affairs in Wadai and the spread of the Senussi movement, though the most recent developments in this direction have occurred since the book was written. M. Gentil does not confine himself solely to his own personal work, but speaks also of that of his coadjutors, giving information, *e.g.*, as to the mission of M. Bretonnet, as well as on the ill-fated mission of M. de Behagle, whose death seems in great measure to have been occasioned by his own rashness. The purely geographical results are summarized in an appendix which tabulates the astronomically fixed positions. Of these the latitudes were obtained by circummeridian altitudes of the sun and stars, while the longitudes of the principal points are based on equal altitudes, and of the rest, by a double transport of time from the first. The main climatic characteristics of the territory are also sketched, three distinct zones being described as lying between 5° N. and 6° 45′; 6° 45′ and 9°; and 9° and 13°, respectively, the last-named parallel marking the commencement of Saharan conditions.

The Moors.

'The Moors. A Comprehensive Description.' By Budgett Meakin. London: Sonnenschein. 1902.

In this, the concluding volume of Mr. Meakin's important "trilogy" on Morocco, its people and history, we are presented with an amount of original matter which to some extent gives the work an even higher claim to recognition than its two predecessors. In dealing with the history and geography of the country, Mr. Meakin was naturally dependent more or less on previously published matter, though his untiring researches through the whole range of Moroccan literature, much of it little known even to students, placed his volumes far above the level of mere compilations. The present work, however, is based almost entirely on investigations at first hand among the people themselves. In the execution of his self-imposed task of describing the Moors in their most intimate social and religious relations, Mr. Meakin spared no pains to qualify himself by long residence in the country, during which he lived as a native in native dress, and was thus able to study the people, not as an outsider, but as one of themselves; while the accuracy of his

picture is further vouched for by the fact that every one of his notes was submitted to the criticism of a representative group of natives before being incorporated in the work. In this way many inaccurate ideas respecting the Moors have been brushed away. The various aspects of Moorish life and character are depicted in an exhaustive fashion, the author taking as his model Lane's famous treatise on the Modern Egyptians. Some of the information is of considerable value in connection with current events, especially that relating to the general attitude of the people to outsiders and the conditions of trade and industry in the country.

Nigeria.

'British Nigeria. A Geographical and Historical Description of the British Possessions adjacent to the Niger River, West Africa.' By Lieut.-Colonel A. F. Mockler-Ferryman. London: Cassell. 1902.

This is an extension of the section on Nigeria in the author's former work on British West Africa, the old matter being revised and partially re-written. It forms a useful compendium of the history of the Nigeria Protectorate, both under native rule and since the first introduction of British influence, with a sketch of its present condition and prospects. The people and their customs are described at some length, with some items of folk-lore.

Tripoli and Tunis.

'Aus den Staaten der Barbaresken.' Von Dr. E. Dagobert Schoenfield. Berlin: Dietrich Reimer. 1902.

This work consists of two parts; the first dealing with Tripoli, the second with Tunis. The section on Tripoli is perhaps the more valuable, as existing literature on that country is more scanty. The author spent three winters there, made a journey in the Fezzan deserts, and visited the ruins of Leptis Magna; but besides describing his own experiences, he has much to say on the general characteristics of the land and its inhabitants, and the present political situation. The illustrations are of unusual excellence.

AMERICA.

Irrigation in the United States.

'Irrigation in the United States.' By Frederick Haynes Newell. New York: Crowell & Co. 1902.

Mr. Frederick Haynes Newell has, for twelve years, been engaged in investigating the problem of irrigating the arid regions of America. His book does not profess to be a technical one, but rather one which will give, to the amateur and the farmer, a general idea of the methods and systems by which homes may be made in tracts which, at first sight, seem inhospitable and desolate. He speaks of water as the substance which, more than any other, affects the health and industries of man, especially in all agricultural pursuits. The first chapter gives a map, showing that, while the well-watered lands near the east and west coast of America have passed out of the hands of Government into private occupation, there remains in the central arid regions a vast area of vacant public land, about two-fifths of the whole area of the States, which should, both in the interests of the State itself and of the increasing population, be made available for settlement as far as the available sources of water-supply admit. Mr. Newell points out that the laws, which regulate the disposal of public lands

in square chess-board blocks, are suitable to those tracts where cultivation without irrigation is practised, but are not suited to areas in which the division of farms must be regulated mainly by the physical features of the country, and especially by the possibilities of irrigation. These possibilities are gauged by the volume of water which can be obtained from the rainfall. A series of diagrams and maps are given, showing the intensity of the rainfall in different parts, and the proportion of that fall which runs off the land; this proportion is, naturally, least in the arid regions and greatest in the humid ones, and it varies from 50 per cent. in tracts of heavy rainfall near the coasts, to nothing at all in some places where the entire rainfall is absorbed and ultimately lost by evaporation.

The effects of irrigation in the arid regions of America are illustrated in the book by pictures of the land before and after irrigation works have been constructed. It is said that without irrigation 20 or 30 acres in some parts will support one cow only, but, with irrigation, will feed ten times the number of cattle, or will support a family of three to five persons. The Papago Indians of the south-west appear to have learnt the value of irrigation, for they construct little dams when it rains, and lead the water from the gullies in the hilly ground into a series of hastily constructed terraces, in which they plant their crops. Some 95 per cent. of the vacant public lands are classed as deficient in water-supply, and it is recognized that, owing to the impossibility of providing the necessary water, only a small portion of the whole can be reclaimed for agriculture; but this small portion is some 60 to 70 millions of acres in extent, and large enough to support millions of people if the necessary works are carried out. In order to do this, a regular system of surveys and investigation of the sources of supply and possible sites for reservoirs has been in progress in America for years.

The author, after giving a brief description of the simplest methods of ascertaining the volume of water which is flowing in a stream, mentions the difficulties which have arisen as the number of small canals, or "ditches," as they are called in America, have increased on a river, and the different owners of them have disagreed as to their rights to the available supply. These disputes are brought prominently forward when there is any scarcity of water, and have led to violence and disorder. One method of adjusting such disputes has been for the various irrigators from a particular stream to appoint one of their number to distribute the available supply, and to fix certain days and hours when each claimant may draw off his proper share. This is a system well known on the great canals in Egypt and India, where regular "tatils," or systems of rotation, are established by Government according to the necessities of the case.

Chapter IV. describes various devices for measuring and dividing the volume of water in small channels; it refers to the curious "miner's inch," which had its genesis in the mining districts, when a comparatively small volume had to be divided among a number of miners. The measuring box, illustrated on p. 127, is ingenious, and would be of practical use in many irrigating systems where a "head" of water is available. In some parts of the world water is sold for irrigation by volume, but, so far, no satisfactory module has been found which will work well in cases where there is no marked difference in level between the main channel and the one into which the water has to be measured, and which will not choke with weeds or floating sticks. In India such difference in level is not often available, and the water is always sold by the area irrigated, without reference to the volume used—a system which encourages waste on a large scale.

The cheapness of timber in America has led to the use of that material in irrigation works to a larger extent than in other parts of the world. Mr. Newell describes the "flumes" of various kinds, which are made for the carriage of

irrigation supplies across valleys and over rivers, or under other channels. In some cases these flumes are made of circular sections, bound together with external bands of iron, so forming a continuous wooden pipe. These often extend for considerable lengths, winding, like great snakes, through the woods, along the hillsides, and up and down across the valleys.

The chapter on reservoirs is full of interest. Large tracts of land in America, in Africa, in India, and, indeed, in many other parts of the world, can only be efficiently cultivated if the flow of the rivers is regulated, and their waters conserved, by impounding the surplus of one period for use in irrigation at a later time. Mr. Newell gives, first, a word of caution, pointing out how many disappointments there have been with reference to this class of irrigation works; how often comparative failure and financial loss have followed when projects have been carried out by engineers who have accepted the statements of the "oldest inhabitants" as to the volume of water to be secured, instead of conducting, through a number of seasons, the necessary gauging of the streams in order to correctly ascertain the amount of water which a given area of country would supply. This chapter would have been doubly interesting to those engineers who have to deal with such matters, if Mr. Newell had given the results of his experiences as to the proportion of the flow-off from a catchment which could be obtained under varying conditions of soil, of climate, and of rainfall. The question is one of great and growing importance, as the increase in population is demanding more and more, in all parts of the world, and notably in South and East Africa, the construction of works to impound the rainfall. Such works require the construction of dams across valleys to form the reservoirs, and we have in this chapter a brief description of "rock filled" dams, of masonry dams, of wooden dams, and of earthen dams. The latter are constructed in America sometimes by the hydraulic process, by which the material to form the dam is both excavated and carried to the site by streams of water flowing at high pressure. The speed and small cost at which material can be moved in this way is extraordinary, but the system, of course, is only possible where water, at high pressure, can be obtained, either naturally or by pumping, at a very moderate cost.

The great value of water has led to many plans for its economy; among these the system of sub-irrigation of orchards and root-crops is one of the most remarkable. Under this system the water is not applied to the surface of the ground, as is usually the case, but is conducted by perforated underground ducts to the neighbourhood of the plants. The system has not been very successful in orchards, owing, it is said, to the roots, in their eagerness to get to the water, seeking out the ducts, choking the outlets, and wrapping themselves round the pipes; in the case of root-crops the system has answered, as the crop is removed every year, and the roots do not choke the pipes. This system must be a very expensive one in first cost.

In every irrigation system the most important factor is the "duty" to be obtained from the water. This "duty" is expressed in different terms in different parts of the world. In India it is usual to measure it by the number of acres which can be irrigated by 1 cubic foot a second flowing for a certain time. In Egypt it is usual to measure it by the cubic metres of water supplied to an acre in twenty-four hours. In America it seems to be usual to measure it by the number of inches in depth which it is necessary to apply to the field in the season. The "duty" of water varies greatly in different soils, in different climates, and for different crops; the statistics given in Mr. Newell's book are useful so far as they go, and it is remarkable that in some of the States laws have been made fixing the duty for apportioning water at the high rate of 66⅔ acres per cubic foot per second.

This, in an irrigating season of one hundred days, is equivalent to a depth of 36 inches in the field, which is a very large volume.

The sums paid for irrigation vary greatly. In South Africa £1 to £1 3s. an acre is paid; in India the average charge is about 2½ to 3 rupees, or say 4s. an acre; in Egypt cultivators will pay £2 to £3 an acre, in addition to the ordinary land tax, for water pumped on to cotton-fields; in America Mr. Newell gives the average as $1¼, or say 5s. an acre, but the rate is in some cases (p. 326) as high as $15 and $30 per acre for an aggregate depth of 1 foot of water delivered on the land.

The researches made by the American officials have shown that, in the arid states of America, there is estimated to be a sufficient supply of water, if it is conserved by reservoirs and other irrigation works, to render 60,000,000 acres culturable. Of this area some 4,000,000 acres was actually irrigated in 1890, and some 7,000,000 acres in 1900. The increase in area is great, and compares favourably with the progress made in an equal period in India, where the Government, encouraged by the fact that the existing irrigation works pay collectively about 6 per cent. on the capital invested in them, has appointed a commission on the subject, and it is anticipated that a large extension of irrigation works will be the result.

Mr. Newell, in the latter half of his book, deals with underground water-supply, with irrigation law, with irrigation by pumping, and he gives a general description of the irrigation in the twelve territories which lie in the arid tracts. The book is illustrated by numerous sketches and plates, and it will be useful, not only to those who are interested in irrigation from a purely agricultural point of view, but also to irrigation engineers, who will find in it many facts of value to them in their profession.

R. B. Buckley.

South America.

'The Great Mountains and Forests of South America.' By Paul Fountain. London, etc.: Longmans. 1902.

Like its predecessor, which treated of the wild life of the southern half of North America, this work will be welcomed by those nature-lovers who prefer pictures of bird and animal life in its natural surroundings to dry scientific treatises. From their point of view, it is perhaps the most attractive book on South America that has appeared for many years. The writer makes no claim to be a geographer, and his somewhat fragmentary notes of travel in the inner recesses of the continent (including a voyage on the Purus) hardly add to our knowledge of its topographical features. But his graphic word-pictures of natural scenes, whether in the Andes or the great forests of Brazil, are valuable as bringing home to the mind with unusual force the typical characteristics of the different regions of South America.

GENERAL.

Maps and Map Reading.

'Notes on Maps and Map Reading.' By Lieut.-Colonel H. M. E. Brunker. London: Clowes & Sons. 1902.

This is a useful little book which essays to reduce a special branch of military education to a few practical and elementary rules.

In the introduction it is satisfactory to hear that the War Office regulations of May, 1902, at last recognize the value of small-scale maps for purposes of military instruction. A scale of 1 inch per mile is the very largest which is applicable to

such wide areas as modern armies will manœuvre over in the course of a campaign, whilst it is quite probable that the scale of 4 miles to the inch will be found to be the best standard scale for practical purposes in the field.

Recognizing this fact, the writer has placed far too much stress on the reading of contours. Accurately contoured maps on the scale of 1 mile to the inch will never be attainable of any country that has not been subjected to a rigorous course of exact survey. For larger-scale maps and purely local purposes the contour is, of course, the only scientific method of showing relief, and a knowledge of their significance and a capability of rapid interpretation of them is undoubtedly an important item in technical education. But for the smaller-scale maps (which will be the standard military maps of the future), the continuous contour system of topography will inevitably be found to be inapplicable to any but comparatively level country. For mountainous country it is misleading and dangerous. The scale does not admit of a less vertical interval than, say, 100 feet, and a 100-foot hill may be a very important military feature. This on the map would only be represented by one single line, or loop, and that single line might represent (if not marked by figures) a depression rather than an elevation. Moreover, accuracy of contouring by mere eye sketching (such as is necessarily resorted to in most military map-making) is very unequal. The American 1-inch standard maps are perhaps the best example of the system, but for the vast mass of the unmapped countries with which England has yet to deal, the elaboration of American methods will be found impossible. Even when possible the result is admittedly misleading in detail. Consequently officers and men should be equally trained in the far readier processes of map-reading from topographical illustrations of the Indian Survey type, where eye sketching by means of hachuring takes the place of contours; where elevations and depressions are unmistakably differentiated; and where relative heights are determined at once by actual figures on the face of a map. To cover the face of a military map with figures denoting height above a given datum is the really practical way of giving instant information to the map-reader of a small-scale map. Cover from the fire of an enemy, etc., may be a matter of a few feet of elevation more or less. Such details cannot be expected from small-scale maps—not even from the 1-inch Ordnance maps of the English Survey.

Colonel Brunker's book marks a long step in the right direction. He does not tell us everything (*e.g.* how to "set" or "orient" a map that is not mounted on a stiff board), but it is useful all through. The doubt about it is the uncertainty whether he has quite grasped the nature of that map of the future which must inevitably be used on the field of action if lives or opportunities are not to be thrown away.

T. H. H.

History of Geography.

'Manuali Hoepli.' L. Hugues. Cronologia delle Scoperte e delle Esplorazioni Geografiche, dall' anno 1492 a tutto il secolo xix. Milan: Hoepli. 1903.

Prof. Hugues here gives a carefully compiled summary of geographical exploration from 1492 to 1900, arranged chronologically. It should prove most valuable for purposes of reference, forming as it does to some extent, with the help of the excellent index, a much-needed Dictionary of Geographers. The list of names is fairly exhaustive, including many less-known travellers, as well as writers like Glareanus and Varenius. Some mistakes and omissions were no doubt unavoidable. Thus, Sir H. Johnston appears (once only—under 1883) as N. H. Johnston, and we miss the name Ravenstein, though we find such names as Ruge, Hamy and Gallois duly entered.

THE MONTHLY RECORD.

THE SOCIETY.

Award of the Victoria Medal to Dr. Sven Hedin.—At the meeting of the Council of the Society on December 8, it was decided to recognize the great importance to geography of the scientific work performed by Dr. Sven Hedin in Central Asia, by the presentation of the newly instituted Victoria Medal, awarded for the first time in 1901 to Mr. Ravenstein. As will be remembered, this medal is to be given, not annually, but as occasion may arise, to such travellers or geographers as may be regarded as entitled to special recognition for the value of their work. It thus to some extent takes the place of the special medals which have in the past been awarded to such travellers as Stanley or Nansen, who have already been holders of the ordinary medals, but whose further services to geography have called for some additional recognition by the Society. Dr. Sven Hedin occupies a similar position, having received the Founder's Medal in 1898, after his return from his first great expedition, while the high appreciation in which his work is held is further shown by the fact that the award has probably been made for the first time on an occasion other than the Anniversary Meeting of the Society. It has quickly been followed by the presentation to the explorer, during his visit to Edinburgh, of the special "Livingstone" Medal of the Scottish Geographical Society.

EUROPE.

The Basin of the Arno.—In the *Rivista Geogr. Ital.*, June and July, 1902, Prof. Oberti treats of the hydrographical history of the Arno basin. After discussing the uncertain morphology of earlier geological periods, he states that in Pliocene times the Arno did not exist, but that the lake of the Mugello was drained through the lower lake of Montevarchi and the Val d'Ambra to the sea, while a lake in the Casentino valley sent its waters to the site of the present plain of Arezzo, and thence through the lagoon of the Chiana valley to the gulf of Chiusi. Towards the end of the period orogenic movements of such intensity occurred as to define the present morphology of the basin. The land rose to the south-east and sank to the north-west, while a fault on the line Florence-Signa drew off the waters of the lake of Mugello and Valdarno to the west, where they reached the sea beyond Cascina. The waters of the upper Arno basin, no longer finding an outlet by the Val d'Ambra, rose till they poured out into the Sieve. A lake of no great size remained in the lowest part of the Casentino valley, partly separated from the Arno basin, and communicated by the narrows of Chiani with the lacustrine basin of the Val di Chiana, the waters of which, joined by those of the lakes of Perugia, Montepulciano, and Chiusi, made their way to the Tiber. The narrows of Chiani became the dividing point between two opposite tendencies—active erosion in the north and deposition of sediment in the south—so that the streams on the northern side tended more and more towards the Arno, which gradually extended its basin southwards. Prof. Oberti gathers from various writers the history of this southern displacement, and mentions the engineering works erected to check it in the seventeenth and eighteenth centuries.

Settlements in the Netherlands.—A series of interesting articles by Dr. H. Blink, on the settlements on and around the Drente plateau, has appeared in the *Tijdschrift* of the Royal Dutch Geographical Society, Deel xviii. No. 5, and Deel xix. Nos. 1, 4, and 6. Hitherto the history of settlement in Holland from an anthropogeographical and economical standpoint has been little studied, and Dr. Blink desires to fill the gap. He has chosen the Drente plateau for the subject of his first essay, because settlements of very old and more modern types occur here side by side. He describes the old German colonies on the edge of gently sloping hills which presented good ground for cultivation. The villages were built in irregular groups of houses with open spaces between them. In the fen colonies, on the other hand, the houses skirted the roads, paths, or canals in long rows. Dr. Blink describes how turf-cutting and cultivation progressed hand-in-hand in the Groningen fen colonies, and how the development of the peat industry led to the construction of canals and the growth of shipping as the peat was carried to more and more distant markets; and treats of the manufactures that have sprung up in more recent times. The details concerning the various land tenures, the houses and the mode of life of the villagers, the systems of working the peat, etc., combine to form a very instructive picture of past times in Eastern Holland.

North Sweden as an Agricultural Country.—The adaptability of the northern part of Sweden for cultivation has been keenly debated, and very opposite opinions have been expressed; some of the disputants maintaining that the natural conditions prohibit any great development of agriculture, while others dream of colonization on a large scale. In *Ymer*, No. 3, 1902, Prof. Högbom sets forth the actual conditions. As regards climate, he points out that North Sweden has the advantage of Finland in that the night-frosts are more severe in the latter country, where, however, the agricultural population is more numerous. If, too, the crops obtained in Northern Sweden be compared with those of Southern Sweden, it appears that the yield is not less than on average lands further south. Prof. Högbom then passes in review the physical conditions of the country, dividing it into four regions—the coast and fringing belt of islets and rocks (the *skärgård*); the region of marine clays and river sediment; the region of moraines and bogs; the highlands and lake district. Along the coast and *skärgård* the finer particles have been washed away by the sea as the land has risen, and this process is still going on. Only in a few sheltered spots are small areas of available soil left behind. The second district extends inland to the highest level reached by the sea after the inland ice melted away and the morainic deposits were left. This limit varies in different parts from 650 to 900 feet above the present sea-level. Here the sand, light soil, and clay washed out of the moraines are deposited in the valleys and low-lying lands, and old river deltas form good land for the farmer. This is the agricultural land of the country *par excellence*. Adjoining it is the region of morainic accumulations and large bogs, where the material of the moraines covers most of the surface and has not been sorted by water, so that the ground is for the most part encumbered with stones, and cannot be utilized, though the chemical constituents of the soil render it naturally fertile. The bogs, some of which are 6 or 7 miles in extent, are, and might be more extensively, utilized as meadow-land. In the region of the highlands and ice-lake sediment the valleys are often filled with fertile soil collected by lakes and streams, and cultivated lands are found as high as 1600 feet above sea-level. These are especially productive where they contain lime derived from the Silurian formation of central Jämtland. The elevation and climate are the chief obstacles to cultivation, but the frosts are less severe than might be expected. Prof. Högbom has collected statistics showing the growth of population and extension of agriculture, etc., in the various regions, and exhibits these details in a map and diagrams.

Lakes of the Kostroma Government.—The valley of the river Kostroma in its middle and lower course lies 230 to 390 feet above sea-level, while in the source-region at Soligalich the normal height of the river is only 436 feet. Its valley is about 20 miles broad in the lower part, owing to the combined action of the Kostroma and Volga, which flows up the Kostroma in spring to a distance of 40 miles, checking the current of the latter and causing much erosion of the bed-rock and deposition of alluvium. At the present time the spring flood does not extend to the limits of the valley, which were evidently at a former period, before the river-beds were cut down so low, the banks of a great lake. The basin of the river and its tributaries, a hilly belt that slopes south-eastwards to the Volga from the boundary of the Government, is now studded with a number of small lakes, some of which were examined by M. Grachef in 1901. In the neighbourhood of the lakes in the Uzoksa valley the villages are built on piles 3 feet 6 inches to 12 feet high, according to the situation, for in the spring large tracts are flooded, and these villages stand, like Venice, in the midst of the water, communication being possible only by boats. As the land is so long covered by water, the only crop that can be raised is hops. The hop-yards extend over large areas, yield a good profit to the inhabitants, and supply the chief article of trade. The chief lakes described by M. Grachef are the Velikoye, Sloinskoye, and Idolomskoye, in the basin of the Uzoksa (or Uzoka), right-hand tributary of the Kostroma; and the Galich, Chukhloma, and Gushcha, drained by eastern tributaries of the river. The largest of all is the Galich, with an area, according to Strelbitski, of 29¾ square miles. The water is shallow, the greatest depths occurring along furrows which seem partly to form continuations of the beds of the streams that feed the lake, partly to follow the line of the banks. At high water the river Beksa flows back into the lake and raises its level. The lake is frozen over from about November 7 to May 7. The Gushcha lake slopes down to a hollow near its northern bank. The depth of sudden change of temperature (*Sprungschicht*) is at 26 to 30 feet (temp. 38° Fahr.); in shallower places the water gradually cools (in July) from 76° at the surface to 44° at the bottom. The water of the Pokheyevskoye lake, which has a bottom of firm clay and bare banks, is peculiarly transparent. The following table gives the dimensions, etc., of some of the largest, deepest lakes:—

	Max. length in miles and furlongs.	Maximum breadth in miles and furlongs.	Maximum depth in feet.	Mean depth in feet.	Transparency in feet.	Colour in the Ule-Forel scale.
Galich	10 5	4 0	14·8	5·4	2·5	—
Chukhloma ...	5 6	4 8	14·8	4·9	—	—
Gushcha ...	0 2·6	0 1·8	68·2	23	1·6	20
Pokheyef ...	0 2	0 1·8	62	29·5	14·8	—
Velikoye ...	1 5	1 2	6	2	4 to 6·5	16 to 17
Idoloma ...	1 2	0 4·5	—	4		

Zemlevedeniye, Nos. 2 and 3, 1902.

ASIA.

Mr. C. W. Campbell's Expedition in Mongolia.—Mr. C. W. Campbell, of H.M. Consular Service in China, who first became known to geographers for his journey through Korea to the Ch'ang Pai Shan, described before the Society in 1892, has lately returned to this country after accomplishing an important journey through Eastern Mongolia, extending in all to about 2500 miles. Parts of his route have probably not been traversed previously by Europeans, while he appears

to be the first Englishman (at least, who has given any account of his journey) to travel at all in Eastern Mongolia and the Kerulon valley.* The expedition had been planned for 1900, but was then frustrated by the Boxer troubles. The start from Peking was eventually made on June 3, 1900. Proceeding *viâ* Kalgan, Mr. Campbell reached the Anguli Nor, and then made a tour north and north-east through Chaharia by an unbeaten track to Dolon Nor, visiting the old Yuan capital, Shang-tu, on the way. He then visited the Dalai Nor, and thence went north and north-east to the Khalka river, which he followed for some days to the north of Buir Nor, afterwards striking across to the Kerulon, and getting a view of the great Dalai Nor from a hill called Bogdo-ul. The Kerulon was followed to the district of the Tsetsen Han, overlord of the Western Khalkas, whence Mr. Campbell struck across to Urga, which he reached on September 6. From Urga he made two long trips and one short excursion, during which he visited the Kentei mountains, traced the Kerulon to one of its sources, and finally traversed the Orkhon valley, visiting the old Turkish monuments brought to light by Yadrintseff and Radloff, the ruins of the old Uigur capital, Hara-balgas, and the celebrated monastery of Erdeni-tsu, the probable site of the ancient Kara-koram. On the main journey to Urga he was accompanied by an Indian sub-surveyor lent by the Indian Government, who executed a survey with the plane-table, while Mr. Campbell himself made a series of barometrical and temperature observations, took observations for latitude and compass variation, and put together a fair collection of plants. It is interesting to compare this journey with that of the old Jesuit traveller Gerbillon, whose journeys led, broadly speaking, over much the same ground in the seventeenth century.

Minerals and Mining in Korea.—So much has been written on the subject of the mineral resources of Korea, that the report of the British Consul at Chemulpo with regard to the question will be read with interest. The American gold-mining concession at Wonsan employs over four thousand Korean labourers, works five mines, and has exported gold to the value of £150,000 during the past year. A British company has commenced work on a powerful vein of pyrrhotine carrying copper for a width of 13 feet, and have also discovered seams of coal of a highly anthracitic character.

The Kirghiz Steppe in the Semipalatinsk Government.—In 1898 and 1899 M. Tikhonovich, with three companions, investigated the Kirghiz Steppe with the object of ascertaining the general condition of the water-supply and the capabilities of the soil for cultivation. His journeys extended over some 44,000 square miles, between 48° and 53° 40′ N. lat. and 75° and 81° E. long. The steppe is in general a plain, the highest point, in lat. 51° 30, having an absolute elevation of only 650 feet, while the Irtish sinks from a height of only 423 feet at Pavlodar to 143 feet at Omsk, after a course of 260 miles. In the south a ring of mountains, culminating in the Kizil-ra (the Kizil-tash of Semenof), 5080 feet high, forms the watersheds between the Irtish and the Balkash lake and between the Irtish and Ishim. On the Balkash slope there are numerous streams, but hardly any lakes; in the elevated country there are lakes fairly well supplied with water by streams; and in the steppe lakes are numerous, while almost the only river is the Irtish. In the Barjanauly and Karkarali mountains some of the lakes are of tectonic origin, being connected with the strike of the folds and the slope north-north-westwards, in which direction the sea of early Tertiary times

* Mr. T. W. Atkinson's furthest point in this direction seems to have been Nerchinsk, in the valley of the Argun, but it is not easy to separate the descriptions in his work which are based on his own travels from those derived from Russian works.

receded. Other agents, chiefly eolian, played only a secondary part in their formation. Other lakes, as the Kara-sor (a *sor* is a lake which dries up in summer) and Balikti-kul, are due rather to the action of the wind on loose deposits, many of them lying in coal-bearing strata of little consistency. There are signs, however, that water-erosion was formerly more active in this region, and possibly has assisted in the excavation of the Kara-sor. The remaining lakes may be divided into old lakes of the primeval steppe, old lakes of the old coast belt, and lakes formed in the Post-Pliocene period. The first are connected with a negative displacement of the coast-line in the Oligocene period, the second with abrasion during the early Tertiary transgression, and the third are the result of the level surface of the steppe. The last are fresh or only slightly brackish, and lie at a higher level than the salt lakes in basins of Oligocene clays. The tectonic basins in the mountains are fairly supplied by streams. In general the lakes are disappearing, but this does not prove that the whole region is drying up. Besides common salt, the waters of the lakes contain potassium oxide, chloride, and sulphate, calcium sulphate, magnesia, magnesium chloride, alum, etc.

The Founding of Fort St. George, Madras.—Mr. William Foster, whose previous contributions to our knowledge of the early trading operations of the English in India are well known, has placed students under a fresh obligation by the publication of extracts from early documents relating to the founding of Fort St. George, which have hitherto been hidden away in the India Office records. As Mr. Foster points out in his preface, the history of Madras and its fortress has been dealt with by many historians, but the records to which these have had access have been limited to those available in the city itself, which commence only in 1670. The present selections, many of them taken from the important collection of "original correspondence" preserved at the India Office, take us back to the first establishment of the settlement and its history under Hindu rule, and therefore supplies a hitherto missing chapter of great interest. Mr. Foster weaves his extracts with much skill into a connected narrative, allowing the old writers to tell the story in their own words where possible, but supplying the necessary connecting links and elucidations, sometimes gathered from contemporary Dutch records. Before the founding of Fort St. George, the English had been established at Masulipatam, where they were subject to the exactions of the Mohammedan rulers of Golconda and their satellites, and were placed at a great disadvantage as compared with the Dutch, who had a settlement at Pulicat, some 200 miles to the south, under the milder administration of the Hindu king of Vijayanagar. In 1626 they obtained a grant of land at Armagon, a little north of Pulicat; but the conditions here too were unfavourable, and the English factors were ready to seize any opening for the establishment of a post still further south. The desired opportunity was afforded by the overtures made by the Naik of the district round Madraspatam, as the site of the future city was then called. In the negotiations with the Naik, as also in the actual founding of the fort (1640), the details of which are fully elucidated by Mr. Foster's extracts, Francis Day played a prominent part, showing much determination and initiative, though ill supported by his superiors. Much of the responsibility was, however, shared by Andrew Cogan, to whom, Mr. Foster thinks, sufficient credit has not hitherto been given for his part in the undertaking. Several misstatements which have obtained currency with regard to the founding of the settlement are also corrected. Thus Mr. Foster shows that the original grant by the king of Vijayanagar was not made by Sri Ranga III., as is usually stated, for he had not then come to the throne; also that it did not hand over a district 5 miles long by 1 mile wide, for in 1645 the English appear to have possessed only Fort St. George and its

immediate vicinity. The original name given to the settlement was Chennapapatam, after the father of the Naik, whence comes the present native name of Madras—Chennapatam. But the old name held its own with the factors. The first instance of the abbreviated form occurs in 1642 (as Maddaras); but as in the original the word comes at the end of the line, and has a mark of contraction over it, we cannot infer that this form had yet become general.

Perim Island.—Miss Raisin, D.SC., describes Perim in a paper on the geology of Perim island in the *Geological Magazine* (May, 1902). It is about 3 miles long, and 1½ mile distant from the mainland on the east, and 9 to 10 miles on the west. It rises in a horseshoe shape, open to the south, out of a shallow sea, the 5-fathom line curving into the harbour. Low plains, evidently raised beaches, under 12 feet above the sea-level, form about half the island, and the hills above this plain rise to 249 feet. The foundation rocks of the island are volcanic, chiefly basalt and volcanic tuffs. The surface, to a depth of about 7 feet, consists of irregular lava blocks embedded in whitish calcareous sand or mud. The horseshoe shape is no evidence of the island having been part of a crater-rim, but its present form is due to denudation and oscillations of level acting on an island built up of volcanic masses (which lie roughly horizontally) within a shallow coral-bearing sea.

AFRICA.

Opening of the Great Nile Dam.—The last stone of the great Nile dam at Assuan, one of the greatest works of the kind the world has ever seen, was laid by H.R.H. the Duchess of Connaught in December, an undertaking fraught with results of the greatest importance for the future prosperity of Egypt being thus brought to a successful conclusion. The whole work has been completed in little more than four years, the contract (which allowed five years for the execution of the work) having been entered into by Messrs. John Aird & Co. in February, 1898, while the first stone was laid by the Duke of Connaught on February 12, 1899. The magnitude of the task, and the energy displayed by the contractors in its execution, may be judged, however, by the fact that at times as many as 23,000 men were employed at once, either at the great dam itself or the subsidiary barrage at Assiut. Of these the greater number were Fellahin, who proved excellent workers, while of the remainder the bulk was composed of skilled Italian masons, whose numbers sometimes amounted to 2000. The history and prospective advantages of the undertaking are clearly sketched by Sir W. Willcocks—the engineer by whom the original plans were drawn up at the instance of Sir W. Garstin—in his work published in 1901, under the title, 'The Nile Reservoir Dam at Assuân and After,' which also gives plans and sections of the dam. Sir W. Willcocks points out the special features which give to the Nile dam a totally novel character, and which, in his opinion, will cause it to mark an epoch in dam-building, not only for irrigation purposes, but for the control of mighty rivers in flood with no less surety than they have hitherto been controlled at periods of low water. As built, the dam follows a straight line across the bed of the river at the first cataract, in the place of the curved line originally chosen by Sir W. Willcocks with a view to obtaining the soundest rock-foundation. Originally it was proposed that the height of the dam should be 100 feet above the zero of the Assuan gauge, but in deference to protests against the periodic submergence of the Philæ temple (though in Sir W. Willcocks' opinion this would cause no greater damage than the partial submergence which will now take place), the height was subsequently lowered by 26 feet. The storage capacity has thus been reduced from 85 to 35 milliards of cubic feet, though the dam is said to be strong enough to hold up 70 milliards, and it would be quite

possible to increase the height at a future date to 93 feet above the zero of the gauge. Even as made, the reservoir will contain over one thousand million tons of water, while, according to Sir Benjamin Baker, the volume of water issuing from it during the summer months, when the needs of the cultivators are greatest, will be equivalent to a river double the size of the Thames in mean annual flood condition. The results to be expected from the completion of the present scheme may be judged from the following facts. For the complete development of its 6,250,000 acres of cultivable land, three-fourths of which depend entirely on perennial (as opposed to basin) irrigation, Egypt has been shown to need 30,000 cubic feet of water per second of summer supply. Of this, in poor years, the Nile supplies only some 8000 cubic feet, leaving 22,000 to be supplied by reservoirs. A discharge of this amount for seventy-five days is reckoned as representing 150 milliards of cubic feet of water, 70 milliards of which, or about half, would be supplied by the Assuan reservoir if the height of the dam were raised. The new supply thus available for the three summer months would, therefore, be considerably greater than the ordinary discharge of the Nile in a poor year. The Assuan dam may be considered as the first step in a still vaster storage system, by which the whole needs of Egypt will ultimately be supplied, whether by the utilization of Lake Tsana or of the great Equatorial lakes.

The Du Bourg Expedition in East Africa.—In the *Journal* for August, 1902, we reproduced from *La Géographie* some particulars of the French Expedition under the Vicomte du Bourg de Bozas, which had traversed the Somali and Galla countries, and was then making its way west through the region between Lake Rudolf and the Nile. Dr. A. D. Milne writes to us from Nimule, a station of the Uganda Protectorate on the upper Nile, announcing the arrival of M. du Bourg's expedition at that place on September 9 last. It had left Adis Abbaba, on the second stage of the journey, on March 4, 1902, and proceeded, apparently by the valley of the Omo, towards the north end of Lake Rudolf, in the neighbourhood of which the routes of Dr. Donaldson Smith and Majors Austin and Bright were crossed. For the first half of the way the tribes were mainly hostile, but, by the exercise of tact, fighting was almost entirely avoided. On reaching the district of the Jalli, a section of the Langu, M. du Bourg was informed that there were "Turks" at Dufile, news of the re-occupation of the Nile province having therefore reached them. They also knew of Khartum and Mombasa, could speak the Nile Arabic, and wore cottons from Zanzibar. Dr. Milne suggests that they must be a remnant of Emin Pasha's mutineers, who were also encountered by the Macdonald Expedition. They live 170 miles west of Nimule. The scientific material obtained by the expedition includes a large number of zoological specimens, anthropological measurements, photographs, linguistic notes, etc. An important discovery of fossil remains was made on the right bank of the Omo. They were identified by Dr. Brumpt, the zoologist of the party, who found many large fish; two species of crocodile; two of elephant (one probably a good deal larger than the existing species, the other quite a pigmy, not more than a metre in height); three different species of *Equidæ*, probably zebra; many hippos; five kinds of pig; and eighteen specimens of antelope. Flint chippings, dating from pre-historic times, were also discovered. M. du Bourg is continuing his journey westward by the Congo route, and hopes to reach Paris by the beginning of April.

First Ascent of Mount Meru.—The great peak which rises from the Masai steppe to the west of Kilimanjaro was ascended in November, 1901, by Dr. Uhlig and Lieut. Schieritz, the former a meteorologist from Dar-es-Salaam, the latter, who has since succumbed to typhoid fever at that place, at the time the officer in charge of the German station at Great Arusha. Lieut. Schieritz's notes on the mountain,

together with reproductions of his photographs, which give an excellent idea of the physical character of Mount Meru, are printed in No. 6 of the last volume of *Globus* (vol. 82, 1902), accompanied by explanatory remarks by Herr Brix Förster. Meru was discovered by Rebmann in 1848, but though its imposing outline has impressed many travellers, few have actually reached its foot,* and only three original pictures of it appear to have been published. It is, as is well known, the second highest mountain in German East Africa, and the more restricted base from which it rises, and the consequently greater steepness of its side, make it, in some ways, a more striking object than Kilimanjaro. Lieut. Schieritz's photographs show the mountain as viewed from the north (from which side no picture had previously been taken), as well as from the south, south-east, and east, while another view shows the spur running out from the main mass to the north-west. The view from the east gives a good idea of the form of the crater, which, according to Lieut. Schieritz, is breached on the north-east, and here gives passage to streams strongly impregnated with natron. There is a smaller crater within the main one. The ascent was made from Great Arusha, through the district of Meru, the surface of which is composed of green hills—in part the spurs of the great mountain. Thence the way leads through the zone of forest, across a corner of the district of Ngongongara, until it emerges into more open country, from which a fine view of the crater is obtained. The forest zone is narrower than on Kilimanjaro, and the succeeding zone of bamboos, which embraces most of the foothills in the south (about 6500 feet), ceases where the actual peak of Meru is reached. The zone of tree-heaths, which has unfortunately been devastated by fire, reaches to about 13,000 feet, the highest point being estimated at about 15,700 feet. No trace of snow seems to have been met with, although the travellers are said to have reached a point about 15,400 feet above the sea. Herr Förster remarks that the volcanic character of the mountain was first recognized by von Höhnel, but this is scarcely correct, as Thomson, in 1885, spoke of it as the "wonderful volcanic cone of Meru" ('Through Masai-land,' p. 143).

The Geology of Cape Colony.—The Annual Report of the Cape of Good Hope Geological Commission for 1900 (Capetown, 1901) has just come to hand. The area surveyed mainly lay in the west of the High Veld in the divisions of Calvinia, Van Rhyns Dorp, and Clanwilliam. (1) *Ex Africa semper aliquid novi.* In Cape Colony, above the Namaqua schists, are the ancient Malmesbury beds of the south-west, and unconformably above these lies the Table mountain sandstone. A new series of beds of slates, sandstones, and conglomerates, differing in character from the Malmesbury beds, has been found overlying them and underneath the Table mountain sandstones in the Van Rhyn's Dorp division, and to them, temporarily at least, the name Ibiquas series has been given. Ripple-marks and animal tracks have been found in the Ibiquas sandstone, and these, with the solitary exception of a piece of quartzite with worm-tubes from the Table mountain sandstone, are the only fossil forms known in rocks older than the Bokkeveld beds which lie above the latter. The Ibiquas conglomerate, which contains granite boulders, may be contemporaneous with the Cango conglomerate, but Dr. Corstorphine urges caution in generalizing about South African geology. (2) A glacial deposit has been found interbedded in the Table mountain sandstone at Pakhuis pass, and the director has no hesitation in adopting his assistants' conclusion that the glacially marked stones have been deposited contemporaneously in these sandstones, and so are probably of early Devonian age, and not a portion of the Dwyka

* The first attempted ascent was that of Teleki and von Höhnel in 1887, but these travellers only reached an altitude of 4900 feet on the south-eastern foot-hills.

conglomerate folded into an anomalous position. The elevation of the Malmesbury beds probably formed the land whose denudation produced the material for the Table mountain quartzite, and from this land surface the ice-scratched stones may have been carried. "The fact is noteworthy that glacial action should have played a conspicuous part on each of the two most ancient land areas" revealed at the Cape. (3) The change from the southern conformity to the northern unconformity, beneath the Dwyka conglomerate (see *Geographical Journal*, December, 1902, p. 631), has been traced northwards from the Ceres division, although, owing to difficulties of transport, the actual spot where the uncomformity begins was not visited. (4) In the area surveyed, unlike the region farther south, basic dykes and sheets have been exposed in nearly all the older series, and are of the same type as those intrusive in the younger rocks of the Central Karros.

Decline of Mozambique.—The serious condition of Mozambique, especially so far as regards its commerce, is alluded to at considerable length in the recently published consular report. In the island of Mozambique itself great stagnation prevails, and signs of commercial decay are everywhere manifest. The exports of last year are little more than one-third of those of the preceding year; two of the most important European trading houses have withdrawn, and even the British Indian merchants find it almost impossible to exist. The causes of this decadence are said to be various, but foremost among them is the disturbed condition of the country, which is absolutely closed to commerce inland, even to within a distance of 10 miles of the coast. There has lately been a considerably diminished rainfall, and the resultant drought has caused widespread famine on the mainland. Moreover, the country has been visited several times by immense flights of locusts, which have done incalculable damage to the cereals and the palms. Firm repression of the rebels in the interior, and a more liberal customs tariff, which at present weighs heavily on the trader, are, it is insisted, absolutely necessary before Mozambique can hope to regain her prosperity.

Climate of the Seychelles.—From the recent report on the Seychelles islands, issued by the Colonial Office, it appears that the year 1901 was distinctly cooler throughout than the preceding year. A mean temperature of 78·48 was noted, as against 79·58 in 1900, and a minimum of 68·4 was recorded—a temperature apparently lower than any recorded in the past six years. The coolest, driest, and healthiest months are from June to October. February is the wettest month, with a rainfall last year of 16 inches; August the driest, with 1·33 inch. The total rainfall amounted to 102·26 inches; it fell on 162 days. July, August, and September show the highest record for wind, the average force being from 9·5 to 14·2 miles per hour; but the islands are all situated outside the hurricane region.

AMERICA.

The Lowlands of South-Eastern Missouri.—The physical history of the lowlands which occupy the south-east corner of the state of Missouri has attracted a good deal of attention, owing to the difficulty which has been felt in accounting for their origin. The fact that the topographical features of the district have never been thoroughly mapped has hitherto made it difficult to obtain the accurate basis of fact on which to build a satisfactory explanation, and such suggestions as have been made have been largely of the nature of guesses. Prof. Marbut, of the Missouri Geological Survey, has for some time devoted his attention to the subject, and has, with the help of assistants, made a careful study of the ground, which has enabled him to offer a detailed explanation of the whole history of the phenomena (*University of Missouri Studies*, vol. i. No. 3, 1902). In the first part of the paper he carefully describes the present surface features and geology of the region, which

consists of belts of lowland, enclosing belts and isolated areas of upland, sloping steeply to the flat-lands which surround them. The peculiarity of the lowlands is that they are not followed continuously by any stream, or even crossed by streams large enough to be considered the cause of their origin. From the first settlement of the region the inhabitants have been struck by these facts, and have sought to account for the lowland belts either as old valleys of the Mississippi, or as due to a sinking of the ground during the earthquakes of 1811 and 1812. Of scientific observers Dr. Branner had accepted the popular view which attributed them to the action of the Mississippi, but without showing how this was exercised; while Mr. Call placed the erosion of one of the principal belts of lowland in Tertiary times, before the deposition of the Tertiary sands and gravels and of the loess of this region. This is shown by Mr. Marbut's examination of the country to be quite untenable, the loess, gravel, sand, and clay having been all alike cut by the force which eroded the lowland. A previous explanation of his own, according to which the main lowland belt lay along the border between an old coastal plain on the one hand and the Palæozoic highlands on the other, the principal ridge being regarded as a *cuesta*, is equally untenable. In putting forward his present explanation, Mr. Marbut shows that the lowlands have been formed neither by subsequent erosion on the part of small tributaries of the larger streams, nor by subsidence between faults, and that the only explanation left is that they were eroded by rivers and creeks which have since abandoned their valleys, positive evidence for which view is, he holds, abundant and conclusive. All the formations except the alluvium having been eroded by the streams to whose action the lowlands are due, the latter are shown to be younger than the loess. The valleys were eroded much deeper than at present, and afterwards filled by the deposition of alluvium, probably during the second glacial epoch. The two main lowlands are shown to have been eroded by the Mississippi and Ohio respectively, the bluffs of each being continuous with those of the respective river-valleys above where they occur. The various stages of river-capture by which the Mississippi has twice been diverted from its former course, so as to invade the original valley of the Ohio, are clearly traced by the writer who points out also the pre-existing conditions which favoured such diversion. Lesser river-captures have also taken place, and in this way the formation of the minor lowlands can likewise be explained. The study is fully illustrated by maps, and forms an excellent illustration of the action of processes by which existing surface features are brought about.

The Caribs of Dominica.—A special Report on the Caribs has lately been furnished to the Colonial Office by Mr. H. Hesketh Bell, the administrator of Dominica island. It gives an outline of the history of these people who, in the time of Columbus, were found in possession of the smaller islands from St. Thomas to Tobago, while the mild and timid Arawaks inhabited Cuba, San Domingo, Jamaica, and the other large islands. The Caribs could not have been long in the Archipelago before the advent of the Europeans, for their settlements were still small and scattered. Their chief strongholds were Trinidad, Santa Cruz, Guadeloupe, Martinique, and Dominica, and in the beginning of the seventeenth century they remained masters of the latter three only, the English, French, and Spanish alike carrying on a war of extermination against them. During a great part of the seventeenth century, their raids and incursions were of almost annual occurrence, and were, moreover, usually successful, even the governors being on more than one occasion carried off or murdered. In 1748 Dominica was set apart as a neutral island for the Caribs, but it did not long remain so, for fifteen years later it was definitely assigned to the British, and the small area of 232 acres allotted as a Carib reserve. In 1791 these people were reported to consist of not more than twenty or thirty families,

and their taste for human flesh had probably disappeared. Their numbers have since apparently undergone no alteration, about four hundred claiming to be Caribs in the reserve. Of these, however, Mr. Bell thinks that not more than a hundred and twenty are of pure blood. They are undoubtedly the last survivors of their race in the West Indies, for the so-called Caribs of St. Vincent are much more akin to Negroes, miscegenation between Negro and Carib having occurred centuries ago on that island where, so far back as 1700, they were known as "Black Caribs" in contradistinction to the "Red Caribs" of Dominica and Guadeloupe. Mr. Bell says, curiously enough, that "the Carib type, even in the remnant which survives to-day, shows an unmistakably Mongolian character, and it would be hard to distinguish a Carib infant from a Chinese or Tartar child." The children have extremely bright and intelligent expressions, and show considerable ability. The hair is described as being very straight, rather coarse, and of a beautiful blue-black colour; the complexion varied from brown to pinkish-yellow. The Carib language is practically extinct. Mr. Bell says, with regard to the pronunciation of the name, that the people themselves all pronounce it as if spelt "Cribe," rhyming with scribe. The Caribs are still famous for their canoes and their waterproof baskets. They are great fishermen, but do not cure their surplus. Simple agriculture is undertaken, and some of them possess a few cattle or sheep. They are exempt from direct taxation, but are required to keep in order the 2 miles of high-road which traverse their reserve. It is suggested that a larger area and some better land should be granted to them. The race is apparently being merged into the Negroes, mixed marriages being very common, and it is feared that in a few decades there will not be a single pure-bred Carib left.

AUSTRALASIA.

Visit to Stuart's Tree, Northern Territory of Australia.—When, in July, 1862, the explorer Stuart reached the shores of the northern sea after his successful crossing of the Australian continent, he signalized the accomplishment of his great undertaking by having his initials (J.M.D.S.) cut in a large tree in a valley some 3 miles from the coast, whilst he also hoisted the Union Jack on one of the tallest trees by the sea-shore, and buried a tin case with the record of his journey one foot south from its base. This record has never since been discovered, but the tree with the explorer's initials was found in 1883 by a party sent by the Acting Government Resident, Mr. G. R. McMinn. It was a species of Albizzia (one of the *Mimoseæ* sub-order of *Leguminosæ*), about 3 feet 6 inches in diameter. The letters were about 2 feet in length, cut very deep, and were then almost as perfect as when formed. In 1893, when visited by the present Government Resident, Mr. Justice Dashwood, and others, it was found that a great piece had been cut out of the tree beneath the inscription, and this seems to have caused decay, which has led to the death of the tree. An expedition to the neighbourhood, on Chambers bay, was lately organized by Mr. Dashwood, and some particulars of this were given in the *Adelaide Observer* for November 1 last. On arriving at the spot where the canister was supposed to have been buried, the shore was found to be encumbered with fallen trees, some half-embedded in slimy ooze, giving the impression that the sea is gaining on the land, in which case the tin and its contents must long since have been destroyed. The party next made for the site of the inscribed tree, only to find a heap of white ashes, apparently not many weeks old, the tree having been almost entirely consumed by fire. It had evidently been dead for some time, and had fallen before being set on fire. The spot was marked by a stake, and bearings taken from other trees with a view to the future erection of a more permanent monument.

POLAR REGIONS.

French Expedition to Northern Spitsbergen in 1693.—In the *Bulletin de Géographie Historique et Descriptive* for 1901 (No. 1, p. 32), Dr. Hamy pieces together from contemporary documents an account of a cruise to the north of Spitsbergen in 1693 by four French frigates during the war between Louis XIV. and the "Grand Alliance." It was undertaken with a view to inflicting as much damage as possible on the Dutch whaling fleet in northern waters, this nation then holding a virtual monopoly of the Spitsbergen whale fishery, in spite of the vigorous efforts put forward earlier in the century by a French company—for a time with success—to obtain a share in the profits. The four frigates were under the command of La Varenne, who had under him a number of experienced Basque officers, including the daring seaman known by the sobriquet "Coursic," or the Little Corsair, while the celebrated Gouin de Beauchene (or Beauchesne Gouin) was captain of one of the ships. The expedition arrived at Magdalena bay, on the north-west coast of Spitsbergen, on July 29, and soon afterwards the first Dutch ships were seen. The records throw an interesting light on the activity of the Dutch whalers in those days, no fewer than fifty ships being met with among the ice to the north-east. They retreated to Bear bay, but were attacked and overpowered in spite of a gallant defence, twenty-eight ships in all falling into the hands of the French. Dr. Hamy reproduces a contemporary chart of the north coast of Spitsbergen, which shows the various bays with a near approach to accuracy, and explains the situation of the rival squadrons during the course of the operations.

Captain Amundsen's Expedition to the North Magnetic Pole.—In the *Geographical Journal*, vol. xx. p. 629, lines 17 and 18, the nautical miles are Norwegian, and as intimated at the beginning of the article should be multiplied by 4 to convert into English nautical miles, making the figures 160 and 120 respectively.

GENERAL.

Geography at Cambridge.—A step which may lead to valuable results in the direction of improving the scientific training of our travellers, has been taken at Cambridge by the Reader in Geography and the University Lecturers in Ethnology and Geology. A course of lectures and practical instruction has been arranged for the Lent Term of 1903, and will be open to members of the University and others who may wish to undertake exploration, or who, during residence or travel in foreign countries, may desire to contribute to our knowledge about them. In addition to lectures by Mr. Oldham, Dr. Haddon, and Mr. Marr on the various branches of geography, ethnology, and geomorphology, the methods of survey will be dealt with by Mr. Garwood and Mr. Hicks. The fee for the whole course will be three guineas, and further information may be obtained from Dr. Haddon, Inisfail, Hills Road, Cambridge, either by letter or by calling at the Museum of Archæology and Ethnology between 10 and 1 o'clock on January 16 or 17.

MEETINGS OF THE ROYAL GEOGRAPHICAL SOCIETY, SESSION 1902-1903.

First Ordinary Meeting, November 12, 1902.—Sir CLEMENTS MARKHAM, K.C.B., F.R.S., President, in the Chair.

The Papers read were:—

1. The President's Address.
2. "World-shaking Earthquakes." By Prof. John Milne, F.R.S.

Second Ordinary Meeting, November 24, 1902.—Sir CLEMENTS MARKHAM, K.C.B., F.R.S., President, in the Chair.

ELECTIONS.—*Frank Adam; William Acton-Adams; Raymond Cecil Allen; Eugene André; John F. Baddeley; Captain Ernald Barnardiston, R.E.; Conrad Clair Biedermann; Francis Bradley Bradley-Birt, Indian Civil Service; David Mather Bowie; George Melville Boynton; Henry Bradford; J. F. Braham; John Bredall; Dr. William Albert Briggs; F. D. Willoughby Bullock; Major J. Alder Burdon, 1st Class Resident, Northern Nigeria; Alan H. Burgoyne; Rev. Chas. George Stratford Burn, M.A.; James F. Cadenhead; Joseph Clark; Major J. L. J. Clarke, East Yorkshire Regt.; Major Stephenson R. Clark, 3rd Batt. Royal Sussex Regiment; Haggitt Colbeck; Harold Cookson; Lieut. E. W. Cox, R.E.; Clarence Craig; Captain Ettrick W. Creak, R.N., C.B., F.R.S.; Herbert H. Crease; Lieut. A. A. Crookshank, R.E.; Captain H. L. Crosthwait, R.E.; Rev. J. N. Cushing; Major Wm. Cooke Daniels, U.S. Army; Richard Stanley Davies; Joseph Burtt Davy; Captain B. Dickson, R.A.; William Byron Drury, Egyptian Army; Captain Cyril Hammond Elgee, 1st Beds. Regiment; Sir Charles N. E. Eliot, K.C.M.G., C.B., His Majesty's Commissioner & Consul-General B.E.A. Protectorate; W. A. Evans; Herbert Charles Fanshawe, late Bengal Civil Service; Dr. Filippo de Filippi; Lieut. Angus Cadden Fletcher, R.A.M.C.; Edmund Forbes; W. A. Freymuth; Captain E. C. L. Fitzwilliams, Army Service Corps; Geo. Reginald Gill; T. Lennox Gilmour, Barrister-at-Law; Captain Fras. Herbert Goldthorp, 3rd Punjab Cavalry; Walton Howorth Greenly, D.S.O., Brigade-Major 12th Royal Lancers; Wm. John Greenstreet, M.A., F.R.A.S.; Wm. Fredk. Hamilton, K.C., LL.D.; Captain Hy. Evered Haymes, R.A.M.C.; Baron Hindlip; Lieut. H. A. Holdich, 5th Gurkha Rifles; Masao Hori; Captain C. G. W. Hunter, R.E.; Geo. Thompson Hutchinson; Robert Robertson Hynd; T. Hall Imrie; John Henry Jacoby; Richard Ll. Jones; Geo. Henry Judd; Joseph Hy. Thomas Keeves; Arvid Ludwig Kellgren, Surgeon, M.D.; Major Fredk. Weston Peile Macdonald, I.S.C.; Peter Joseph MacLeod, B.A.; Theodor Gustav Meissner; Robert Miller; G. H. Milward; Arthur John Charles Molyneux, F.G.S.; Captain Herbert Acheson Moore, South Wales Borderers; Edward A. J. Mulock, Sub-Lieut. R.N.; Henry O'Sullivan; Captain Wm. McMullen Pearson, Indian Medical Service; George Pepper; Major George Pereira, D.S.O., Grenadier Guards; Charles Curteis Philpott; Sydney J. Porter; Wm. Thos. Price; Ernest Protheroe; Reginald Rankin; Walter Redman; William Sheldon Ridge, B.A.; Captain C. L. Robertson, R.E.; William Henry Robinson; Norman Scott Rudolf, M.Sc.; William Rudolf; David Alexander Ruffmann; Charles Herbert Sankey; Frederick A. Saunders, M.D.; Captain Frank R. Sedgwick, R.F.A.; Henry John Selby; H. Redfearn Shaw; Franklin A. Snow, C.E.; Captain James Johnston-Stewart, 2nd Batt. King's African Rifles; Frederic Spence Tatham; Lieut. Frank Robinson Teesdale,*

5th Punjab Cavalry; E. Timperlake, F.R.H.S.; John Forward Toogood; Reginald Tower, His Majesty's Minister at Bangkok; A. John Lyttleton Turner; John H. Udny; F. J. Varley, M.A.; Hans Vischer, C.M.S.; Charles H. Stuart Wade, J.P.; Major F. W. G. Wadeson, 5th Bengal Cavalry; H. Boyd Wallis; Anton F. Wilcken; Sir Andrew Wingate, K.C.I.E.; John Greaves Wiseman, F.R.C.S. Eng.; Harry Forbes Witherby; Captain P. R. Wood, Royal Irish Fusiliers; William Arden Wood, M.A.; John T. Wood, M.A.; Rev. Frederick George Wright, Chaplain to the Forces; Alfred Ernest Young.

The Paper read was:—

"Exploration in Western China." By Captain C. H. D. Ryder, R.E.

Third Ordinary Meeting, December 8, 1902.—Sir CLEMENTS MARKHAM, K.C.B., F.R.S., President, in the Chair.

ELECTIONS:—*Lieut. Joseph Bennett-Yates, R.N.R.; Captain G. A. S. Cape, R.A.; Lieut. Hazeldean Forsyth, R.E.; Alfred Arkell-Hardwick; K. D. Harrison; Lieut.-Col. W. B. Hickie, 7th Royal Fusiliers; Frederick Julius Macaulay; Brevet-Major F. W. Moffitt, Essex Regiment; Sir Francis L. O'Callaghan, K.C.M.G., C.S.I., C.I.E.; Captain Thos. Terence Constantine Purland, J.P.; Colonel Divie Henry Robertson; Commander Arthur Hayes-Sadler, R.N.; Edward John Scott; Major G. S. Sewell de Gana; Lieut. Cecil Minet Staveley, R.N.; Alexander William Thorne.*

The Paper read was:—

"Three Years' Exploring Work in Central Asia." By Dr. Sven Hedin.

Fourth Ordinary Meeting, December 15, 1902.—Sir CLEMENTS MARKHAM, K.C.B., President, in the Chair.

The Paper read was:—

"Explorations in North-West Mexico." By Dr. Carl Lumholtz.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By EDWARD HEAWOOD, M.A., *Librarian*, R.G.S.

The following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are in each case written in full:—

A. = Academy, Academie, Akademie.
Abh. = Abhandlungen.
Ann. = Annals, Annales, Annalen.
B. = Bulletin, Bollettino, Boletim.
Com. = Commerce.
C. Rd. = Comptes Rendus.
Erdk. = Erdkunde.
G. = Geography, Geographie, Geografia.
Ges. = Gesellschaft.
I. = Institute, Institution.
Iz. = Izvestiya.
J. = Journal.
k. u. k. = kaiserlich und königlich.
M. = Mitteilungen.
Mag. = Magazine.
Mem. = Memoirs, Mémoires.
Met. = Meteorological.
P. = Proceedings.
R. = Royal.
Rev. = Review, Revue.
S. = Society, Société, Selskab.
Sitzb. = Sitzungsbericht.
T. = Transactions.
V. = Verein.
Verh. = Verhandlungen.
W. = Wissenschaft, and compounds.
Z. = Zeitschrift.
Zap. = Zapiski.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half-inch. The size of the *Journal* is 10 × 6½.

A selection of the works in this list will be noticed elsewhere in the "Journal."

EUROPE.

Alps. *Quarterly J. Geolog. S.* **58** (1902): 690-702. **Bonney.**

Alpine Valleys in Relation to Glaciers. By Prof. T. G. Bonney, D.SC. *With Sections.*

Central Europe. **Drude.**

Die Vegetation der Erde. Sammlung pflanzen-geographischer Monographien herausgegeben von A. Engler und O. Drude. VI. Der Hercynische Florenbezirk. Grundzüge der Pflanzenverbreitung im mitteldeutschen Berg- und Hügellande vom Harz bis zur Rhön, bis zur Lausitz und dem Böhmer Walde. Von Dr. Oscar Drude. Leipzig: W. Engelmann, 1902. Size 10½ × 7, pp. xx. and 672. *Map and Illustrations.*

France—Vosges. **Boyé.**

Les Hautes-Chaumes des Vosges. Étude de Géographie et d'Économie historiques. Par Pierre Boyé. Paris: Berger-Levrault & Cie., 1903 [1902]. Size 9 × 5½, pp. 432. *Plates. Price 6 fr. Presented by the Publishers.*

France—Waterways. ———

1er Congrès du Sud-Ouest Navigable tenu à Bordeaux les 12, 13 et 14 Juin 1902. Compte rendu des Travaux. Bordeaux: Feret et Fils, 1902. Size 10 × 6½, pp. 478. *Map. Presented by the Publishers.*

France—West Coast. *B.G. Historique et Descriptive* (1901): 313-341. **Pawlowski.**

Le Golfe du Poitou à travers les Âges, d'après la géologie, la cartographie et l'histoire. Par M. Auguste Pawlowski. *Map.*

Germany—Geodesy. **Marcuse.**

Centralbureau der Internationalen Erdmessung. Neue Folge der Veröffentlichungen, No. 6. Ergebnisse der Polhöhenbestimmungen in Berlin ausgeführt in den Jahren 1889, 1890 und 1891 am Universal-Transit der Königlichen Sternwarte von Dr. Adolf Marcuse. Berlin: G. Reimer, 1902. Size 11½ × 9, pp. 30.

Germany—Harz—Lakes. *M.V. Erdk. Halle* (1902): 94-96. **Halbfass.**

Ueber Einsturzbecken am Südrand des Harzes. Vorläufige Bemerkungen von Prof. Dr. W. Halbfass.

Germany—Plant-geography. *M.V. Erdk. Halle* (1902): 14-70. **Schulz.**

Studien über die phanerogame Flora und Pflanzendecke des Saalebezirkes. I. Die Wanderungen der Phanerogamen im Saalebezirke seit dem Ausgange der letzten kalten Periode. Von Dr. A. Schulz. *With Map.*

Germany—Prussia—Magdeburg. *M.V. Erdk. Halle* (1902): 70-94. **Quitzow.**

Die Wische, insbesondere deren Bodenbau und Bewässerung. Von Dr. W. Quitzow. *With Map.*

Germany—Thuringia. *M.V. Erdk. Halle* (1902): 8-9. **Henkel.**

Karsterscheinungen im thüringischen Muschelkalk. Von Dr. L. Henkel. *With Sketch-map.*

Germany—Thuringia. *Vierteljahrshefte G. Unterricht* **2** (1903): 27-32. **Kollbach.**

Bilder aus dem Thüringerwald. Von Karl Kollbach.

Greece and Turkey. *Sitzb. K.A.W. Wien.* 110 (1901), (Abth. I.): 171-182. **Hilber.**

Geologischer Reisen in Nordgreichenland und Makedonien 1899 und 1900 (vorläufiger Bericht). Von Vincenz Hilber.

Holland. *Rev. G.* **26** (1902): 266-275. **Bellet.**

Le dessèchement du Zuiderzee. Par Daniel Bellet.

Holland. *Tijds. K. Ned. Aard. Genoots. Amsterdam* **19** (1902): 909-935. **Beekman.**

Nomina Geographica Neerlandica uit een geographisch oogpunt beschouwd. Door A. A. Beekman.

Discusses various geographical terms.

Holland. **Blink.**

Tijds. K. Ned. Aard. Genoots. Amsterdam **18** (1901): 731–767; **19** (1902): 59–107, 481–514, 936–958.

Studiën over nederzettingen in Nederland. Door Dr. H. Blink. *With Maps.*

See note in the Monthly Record (*ante*, p. 75).

Iceland. **Bisiker.**

Across Iceland. By W. Bisiker. With an appendix, by A. W. Hill, on the plants collected. London: Edward Arnold, 1902. Size 9 × 6, pp. xii. and 236. *Maps and Illustrations. Price* 12*s.* 6*d. Presented by the Publishers.*

This will be reviewed elsewhere.

Iceland. *J. of T. Victoria I.* **34** (1902): 164–181. **Stefansson.**

Iceland: its History and Inhabitants. By Herr Jon Stefansson, PH.D.

Italy. **Baedeker.**

Italy. Handbook for Travellers. By Karl Baedeker. First Part. Northern Italy, including Leghorn, Florence, Ravenna, and routes through Switzerland and Austria. Twelfth remodelled edition. Leipsic: K. Baedeker, 1903. Size 6½ × 4, pp. lxiv. and 564. *Maps and Plans. Price* 8*m. Presented by the Editor.*

Italy—Modena. **Corti.**

Le Provincie d'Italia sotto l'aspetto geografico e storico descritte da Siro Corti. N. 63. Regione Emiliana. Provincia di Modena. Torino, etc.: G. B. Paravia e Comp., 1895. Size 8 × 5, pp. 56. *Maps and Illustrations. Price* 6*d.*

Montenegro. *Blackwood's Mag.* **172** (1902): 303–318. **Wyon.**

Montenegrin Sketches. By Reginald Wyon.

Norway—Fjords. *J. of T. Victoria I.* **34** (1902): 125–151. **Hull.**

The Physical History of the Norwegian Fjords. By Prof. Edward Hull. *With Map and Illustrations.*

Pyrenees. **Scharff.**

Ueber den Einfluss der Pyrenäen auf die Tierwanderungen zwischen Frankreich und Spanien. Von Dr. R. F. Scharff. (Sonderabdruck aus den Verhandlungen des V. Internationalen Zoologen-Congresses zu Berlin, 1901.) Jena: Gustav Fischer, 1902. Size 9½ × 6½, pp. 5. *Presented by the Author.*

Russia—Crimea. *C. Rd.* **135** (1902): 355–356. **Daniloff.**

Sur la géographie physique de la Yaïla occidentale (Crimée). Note de E. Daniloff.

Servia. *Deutsche Rundschau G.* **24** (1902): 407–415, 461–465, 532–542. **Meinhard.**

Durch Serbien. Von Friedrich Meinhard.

Sweden—Geology. **Holst.**

Bidrag till Kännedomen om Östersjöns och Bottniska Vikens postglaciala geologi. Af Nils Olof Holst. (Sveriges Geologiska Undersökning. Ser. C, No. 180.) Stockholm: P. A. Norstedt & Söner, 1899. Size 9 × 6, pp. 128. *Map. Presented by the Swedish Geological Survey.*

Sweden—Geology. ———

Upplysningar till geologisk Öfversikts-karta öfver Sveriges berggrund, upprättad och utgifven af Sveriges Geologiska Undersökning ar 1901, mit einem Résumé in Deutscher Sprache. (Sveriges Geologiska Undersökning. Ser. Ba. No. 6.) Stockholm: P. A. Norstedt & Söner, 1901. Size 9½ × 6½, pp. 62. *Presented by the Swedish Geological Survey.*

Switzerland—Lake of Zurich. **Lozeron.**

Vierteljahrs. Naturforsch. Ges. Zürich **47** (1902): 115–198.

Sur la répartition verticale du plancton dans le lac de Zurich, de décembre 1900 à décembre 1901. Par H. Lozeron. *With Diagrams.*

Switzerland—Rigi. *Globus* **82** (1902): 110–111. **Friedrich.**

Karte des Rigi. Ein Beitrag zur Terraindarstellung. Von Dr. Ernst Friedrich. *With Map.*

United Kingdom. ———

The Climates and Baths of Great Britain, being the Report of a Committee of the Royal Medical and Chirurgical Society of London. Vol. i. The Climates of the South of England and the chief Medicinal Springs of Great Britain. Vol. ii. The Climates of London and of the Central and Northern portions of

England, together with those of Wales and of Ireland. London: Macmillan & Co., 1895–1902. Size 9½ × 6, pp. (vol. i.) xvi. and 640; (vol. ii.) xvi. and 628. *Maps and Diagrams. Price* 12*s.* 6*d. each volume.*

These will be specially reviewed.

United Kingdom—England. *G. Teacher* **1** (1902): 150–166. **Herbertson.**

On the One-Inch Ordnance Survey-Map, with special reference to the Oxford Sheet. By A. J. Herbertson, PH.D. *With Maps and Illustrations.*

United Kingdom—England. **Windle.**

Shakespeare's Country. By Bertram C. A. Windle. Illustrated by Edmund H. New. London: Methuen & Co., 1901. Size 6 × 4, pp. xii. and 220. *Map and Illustrations. Price* 3*s. Presented by the Publisher.*

United Kingdom—England—Cambridge. **Thompson.**

Cambridge and Its Colleges. By A. Hamilton Thompson. Illustrated by Edmund H. New. London: Methuen & Co., 1898. Size 6 × 4, pp. xvi. and 316. *Plan and Illustrations. Price* 3*s. Presented by the Publishers.*

United Kingdom—England—London. *J.R. Statistical S.* **65** (1902): 447–502. **Welton.**

A Study of some portions of the Census of London for 1901. By T. A. Welton.

United Kingdom—England—Malvern. **Windle.**

The Malvern Country. By Bertram C. A. Windle. Illustrated by Edmund H. New. London: Methuen & Co., 1901. Size 6 × 4, pp. xii. and 236. *Plan and Illustrations. Price* 3*s. Presented by the Publishers.*

United Kingdom—England—Oxford. **Wells.**

Oxford and Its Colleges. By J. Wells, M.A. Illustrated by Edmund H. New. London: Methuen & Co., 19—. Size 6 × 4, pp. xii. and 330. *Plan and Illustrations. Price* 3*s. Presented by the Publishers.*

United Kingdom—England—Stonehenge. **Hunter.**

Nineteenth Century **52** (1902): 430–438.

The Inclosure of Stonehenge. By Sir Robert Hunter. *With Map.*

United Kingdom—Ireland. *Geolog. Mag.* **9** (1902): 456–458. **Cole**

On the Geological Structure of Ireland. By Prof. Grenville A. J. Cole.

United Kingdom—Ireland. ———

Department of Agriculture and Technical Instruction for Ireland. Ireland, Industrial and Agricultural. Dublin, etc.: Browne & Nolan, Ltd., 1902. Size 10 × 7, pp. 532. *Maps and Illustrations. Price* 5*s. net.*

A most useful summary of the economic facts relating to Ireland, consisting of a number of articles by experts on the several subjects.

United Kingdom—Rainfall. **Wallis and Mill.**

British Rainfall, 1901. On the Distribution of Rain over the British Isles during the year 1901, as observed at about 3500 stations in Great Britain and Ireland, with Articles upon various branches of Rainfall work. Compiled by H. Sowerby Wallis and Hugh Robert Mill. London: E. Stanford, 1902. Size 8½ × 5½, pp. 60 and 252. *Maps and Diagrams.*

A special article deals with rainfall averages in the British Isles for a series of years.

United Kingdom—Scotland—Hebrides. **Goodrich-Freer.**

The Outer Isles. By A. Goodrich-Freer. Westminster: A. Constable & Co., 1902. Size 9 × 5½, pp. xvi. and 448. *Map and Illustrations. Price* 12*s.* 6*d. net. Presented by the Publishers.*

ASIA.

Arabia. *J.R. United Service I.* **46** (1902): 1419–1435. **Wachs.**

The Present and Future of Arabia. By Major Otto Wachs. (Translated from the "Marine-Rundschau," January, 1902.)

Central Asia. **Roborovsky.**

Results of the Expedition of the Imperial Russian Geographical Society in Central Asia carried out in 1893–1895, under the command of V. N. Roborovsky. Part ii. [In Russian.] St. Petersburg, 1899. Size 12 × 8½, pp. viii. and 296. *Map and Plates.*

China. **Birch.**

Travels in North and Central China. By John Grant Birch. London: Hurst & Blackett, Ltd., 1902. Size 9 × 5½, pp. xvi. and 380. *Illustrations. Price* 10*s.* 6*d. net. Presented by the Publishers.* [Review, p. 64.]

China. **Nichols.**

Through Hidden Shensi. By Francis H. Nichols. London: George Newnes, Ltd., 1902. Size 9 × 6, pp. xxxii. and 334. *Map and Illustrations. Price* 12*s.* 6*d. net. Presented by the Publishers.*

China—Kiau-chou. *Rev. Française* **27** (1902): 646–654. **Servigny.**

Le développement de Kiao-Tchéou. Par J. Servigny. *With Map.*

China—Kwangsi. *Rev. Colon.* (1902): 627–646. **François.**

Notice sur le Kouang-Si. Par le lieutenant F. François.
Itinéraire dans le Kouang-Si. By the same.

Chinese Empire—Gobi Desert. **Futterer.**

Geographische Skizze der Wüste Gobi zwischen Hami und Su-tschôu. Von Prof. Dr. K. Futterer. (*Petermanns Mitteilungen*, Ergänzungsheft Nr. 139.) Gotha: Justus Perthes, 1902. Size 12 × 7½, pp. 36. *Map. Price* 3 *m.* 20 *pf.*

Japan. **Haas.**

Geschichte des Christentums in Japan. Von Pfarrer Hans Haas. I. Erste Einführung des Christentums in Japan durch Franz Xavier. (Supplement der "Mittheilungen" der Deutschen Gesellschaft für Natur- und Völkerkunde Ostasiens.) Tokyo, 1902. Size 9½ × 6½, pp. xiv. and 300. *Portrait.*

This work promises to be, when complete, a valuable addition to our knowledge of European dealings with Japan. The first three chapters give an outline of the early knowledge of Japan current in Europe, and of the first voyages of the Portuguese to the island kingdom.

Korea. *Globus* **82** (1902): 158–161. **Magnus.**

Ein Besuch am Hofe von Korea. Von Friedrich Magnus. *With Illustrations.*

Malay States—Perak. **Rodger.**

Perak Administration Report for the year 1901. By J. P. Rodger. Taiping, Perak. N.D. Size 13 × 8½, pp. 52.

Persia. *J.R. Asiatic S.* (1902): 939–949. **Sykes.**

Historical Notes on South-East Persia. By Major P. Molesworth Sykes, C.M.G. *With Map and Illustrations.*

Persia. *P.R. Artillery I.* **29** (1902): 147–154. **Wyatt.**

The Western Glacis of India. By Captain F. O. Wyatt. *With Map.*

The previous portions of this paper appeared in the same *Journal* during 1900 and 1901.

Russia—Sakhalin. *Tour du Monde*, **8** (1902): 469–480. **Labbé.**

Une Bagne Russe. L'Ile de Sakhaline. Par M. Paul Labbé. *Map and Illustr.*

Russia—Siberia. **Zepelin.**

Das russische Kustengebiet in Ostasien. (Primorskaja Oblastj.) Von C. von Zepelin. Berlin: G. S. Mittler & Son, 1902. Size 9½ × 7, pp. 60. *Maps and Plan. Presented by the Publishers.*

Russia—Siberia. **Ruffmann.**

Across Siberia by Rail. A Trip to the Amur Goldfields. By David A. Ruffmann. (Reprinted from the *Pall Mall Gazette.*) 1902. Size 8½ × 5½, pp. 34. *Presented by the Author.*

Contains some information on mining in Siberia, of the prospects of which the writer takes a sanguine view.

Russia—Siberia. *Rev. G.* **26** (1902): 240–265. **Barré.**

Le peuplement et la Colonisation de la Sibérie. Par Paul Barré.

Russia—Siberia. *Questions Dipl. et Colon.* **14** (1902): 276–287. **Labbé.**

La Transbaïkalie et la colonisation russe. Par Paul Labbé.

Siam. *Fortnightly Rec.* **72** (1902): 551–559. ———

Siam and the Powers. By X. Y. Z. *With Map.*

Written before the conclusion of the recent Franco-Siamese agreement. The map omits a portion of the French sphere of action in Northern Siam.

Singapore—Historical. **Van der Kemp.**

Bijd. Taal-, Land- en Volkenk. Ned.-Indië **10** (1902): 313–476.

De stichting van Singapore, de afstand ervan met Malakka door Nederland, en de Britsche aanspraken op den Linga-Riouw Archipel. Door P. H. van der Kemp.

On events connected with the founding of Singapore in the early part of the nineteenth century.

Syria and Palestine. **Paton**

The Semitic Series.—The Early History of Syria and Palestine. By Lewis Bayles Paton. London: John C. Nimmo, 1902. Size 8 × 5, pp. xxxvi. and 362. *Maps. Presented by the Publishers.*

Tibet. *Petermanns M.* **48** (1902): 137–138, 163–165, 184–187. **Krahmer**

Nachrichten von der Expedition von P. K. Koslow. Von General Krahmer. *With Map.*

Turkey—Palestine. *B.S.G. Genève* **41** (1902): 128–144. **Gautier**

Le lac de Tibériade. Par M. le Prof. Lucien Gautier. *With Illustrations*

Turkey—Palestine. **Macalister.**

Palestine Exploration Fund, Q. Statement (1902): 317–364.

First Quarterly Report of the Excavation of Gezer. By R. A. Stewart Macalister. *With Plan and Illustrations.*

AFRICA.

Abyssinia. **Berkeley.**

The Campaign of Adowa and the Rise of Menelik. By G. F. H. Berkeley. Westminster: A. Constable & Co., 1902. Size 9 × 6, pp. xiv. and 404. *Maps. Price 7s. 6d. net. Presented by the Publisher.*

Abyssinia—Gallas. **Salviac.**

P. Martial de Salviac. Un Peuple Antique au Pays de Menelik. Les Galla. (Dits d'Origine Gauloise), Grand Nation Africaine. Paris: H. Oudin [not dated]. Size 11 × 7½, pp. viii. and 354. *Map and Illustrations. Price 7s.*

A very complete study of the Gallas from the point of view of history, manners and customs, institutions, etc.

Abyssinia—History. **Arab-Faqih and Basset.**

Publications de l'école des Lettres d'Alger. Histoire de la Conquête de l'Abyssinie (XVI^e^ Siècle). Par Chihab Ed-Din Ahmed Ben 'Abd El-Qâder surnommé Arab-Faqih. Traduction Française et Notes par René Basset. Paris: E. Leroux, 1897–1901. Size 10 × 6½, pp. 506. *Price 1s.*

A new translation of the well-known history of the conquests of Mohamed Granye, with valuable critical and explanatory notes. The Arabic text is also published in the same series.

Africa—Bibliography. ———

Catalogue of an extensive collection of books, pamphlets, views, maps, and transactions of Societies relating to Africa and African Islands. Offered at the prices affixed by Francis Edwards, Bookseller, 83, High Street, Marylebone, London, W. October, 1902. Size 8¼ × 5½, pp. 224 and 40. *Presented by Mr. Francis Edwards.*

Africa—Zoology. *P. Zoolog. S.* (1902, vol. ii.): 73–79. **Major.**

Dr. C. I. Forsyth Major. On the remains of the Okapi received by the Congo Museum in Brussels. *With Illustrations.*

Eritrea. **Melli.**

Manuali Hoepli. B. Melli. L'Eritrea dalle sue Origini a tutto l'anno 1901. Appunti Cronistorica. Milan: Ulrico Hoepli. 1902. Size 6 × 4, pp. xii. and 164. *Maps. Price 2 lire. Presented by the Publisher.*

A summary of the history of Eritrea.

French Congo. *Rev. Colon.* (1902): 531–550. **Pauwel.**

De Bangui à Carnot et retour. Par R. de Pauwel.

German East Africa. *M. Deutsch. Schutzgeb.* **15** (1902): 133–138. **Adams.**

Das mittlere Flussgebeit des Lukuledi. Von P. Alf. Adams. *With Map.*

The Lukuledi is the river debouching into Lindi bay.

German East Africa. **Stuhlmann.**
Berichte Land- u. Forstwirtschaft Deutsch.-Ostafrika **1** (1902): 1–23.
Uebersicht über Land- und Forstwirtschaft in Deutsch-Ostafrika im Berichtsjahre vom 1. Juli 1900 bis 30. Juni 1901. Zusammen-gestellt von Regierungsrat Dr. Franz Stuhlmann.

German East Africa—Tsetse Fly. **Stuhlmann.**
Berichte Land- u. Forstwirtschaft Deutsch-Ostafrika **1** (1902): 137–153.
Notizen über die Tsetsefliege (Glossina morsitans Westw.) und die durch sie übertragene Surrahkrankheit in Deutsch-Ostafrika. Von Regierungsrat Dr. Franz Stuhlmann. *With Map and Illustrations.*

Kamerun. *M. Deutsch. Schutzgeb.* **15** (1902): 123–130. **Foerster and Moisel.**
Bericht über eine Erkundung des mittleren Kampoflusses. Von Oberleutnant Foerster. *With Map.*
Bemerkungen zu der Karte des Gebietes am unteren Kampo. Von M. Moisel.
Lieut. Foerster was a member of the recent boundary survey along the southern frontier of the Kamerun.

Madagascar. **Gautier.**
Madagascar. Essai de Géographie Physique. Par E. F. Gautier. Paris: A. Challamel, 1902. Size 11 × 7½, pp. 428. *Maps, Illustrations, and Diagrams. Price 25s.*
This important work will be reviewed elsewhere.

Madagascar. *La G., B.S.G. Paris* **6** (1902): 1–16. **Grandidier.**
Une mission dans la région australe de Madagascar en 1901. Par G. Grandidier. *With Map and Illustrations. Also separate copy, presented by the Author.*

Morocco. *Mém. S.G. Genève* **41** (1902): 41–61. **Montet.**
Le grand Atlas et le Sud-Marocain. Par E. Montet.
The writer made the journey from Marakesh to the coast through a portion of the Atlas range.

Morocco—People. **Meakin.**
The Moors, a comprehensive description. By Budgett Meakin. London: Sonnenschein & Co., 1902. Size 9 × 6, pp. xxii. and 504. *Illustrations. Price 15s. Presented by the Author.*

Niger. *Rev. Française* **27** (1902): 589–600. **Lenfant.**
La navigabilité du Niger. Par Capitaine E. Lenfant.

Nigeria. **Mockler-Ferryman.**
British Nigeria. A Geographical and Historical description of the British Possessions adjacent to the Niger River, West Africa. By Lieut.-Col. A. F. Mockler-Ferryman. London, &c.: Cassell & Co., 1902. Size 9½ × 6, pp. viii. and 352. *Map and Illustrations. Price 12s. 6d. net. Presented by the Publishers.*

North and East Africa. **Pease.**
Travel and Sport in Africa. By A. E. Pease. 3 vols. London: A. L. Humphreys, 1902. Size 13 × 10½, pp. (vol. i.) xviii. and 360; (vol. ii.) xii. and 314; (vol. iii.) x. and 232. *Maps and Illustrations. Price £10 10s. net. Presented by the Publisher.*
This will be specially noticed.

Rhodesia. **Peters.**
The Eldorado of the Ancients. By Dr. Carl Peters. London: C. Arthur Pearson, 1902. Size 9 × 5½, pp. x. and 448. *Maps and Illustrations. Price 21s. net. Presented by the Publishers.*
See review in the *Journal* for November, 1902.

Sahara. *Rev. Française* **27** (1902): 544–550. **Huguenot.**
Les puits au Sahara. Par Père Huguenot. *Map.*

South Africa—Meteorology. *T. S. African Philosoph. S.* **11** (1902): 243–318. **Sutton.**
Some Pressure and Temperature Results for the Great Plateau of South Africa. By J. R. Sutton. *With Diagrams.*

Togo. *M. Deutsch. Schutzgeb.* **15** (1902): 120–122. **Messerschmitt and Ambronn.**
Breitenbestimmungen in Togo, angestellt vom Hauptmann v. Doering. Berechnet

von Dr. J. B. Messerschmitt. Astronomische Beobachtungen von Dr. Gruner, 1897. Berechnet von Prof. Dr. Ambronn.

Resultate der astronomischen Beobachtungen des Herrn H. Klose, 1897.

Tripoli. **Ricchieri.**

G. Ricchieri. La Tripolitania e l'Italia. Milano: Albright, Segati, e C., 1902. Size 9 × 6, pp. 62. *Presented by the Publishers.*

The author considers that the future relations of Italy with Tripoli should be concerned rather with an extension of commercial intercourse than with direct political control.

Tripoli and Tunis. **Schoenfield.**

Aus den Staaten der Barbaresken. Von Dr. E. Dagobert Schoenfield. Berlin: Dietrich Reimer, 1902. Size 10½ × 7, pp. 268. *Plates. Price* 6*m. Presented by the Publisher.*

West Africa. *Rev. Colon.* (1902): 607–624. ———

Rapport de délimitation Franco-Portugaise de la Commission entre le Congo et le Cabinda.

NORTH AMERICA.

Canada—Historical. *P. and T.R.S. Canada* 7 (1901): (Sec. I.) 97–116. **Sulte.**

La Rivière des Trois-Rivières. Par M. B. Sulte. *With Map.*

Canada—Historical. *P. and T.R.S. Canada* 7 (1901): (Sec. I.) 47–96. **Sulte.**

Le Fort de Frontenac, 1668–1678. Par M. Benjamin Sulte.

Canada—New Brunswick. *P. and T.R.S. Canada* 7 (1901) (Sec. IV.): 45–56. **Ells.**

The Carboniferous Basin in New Brunswick. By R. W. Ells, LL.D.

United States—Arkansas. **Branner.**

Annual Report of the Geological Survey of Arkansas for 1892. Volume V. The Zinc and Lead Region of North Arkansas. By John C. Branner. With Atlas. Little Rock, 1900. Size 9 × 6, pp. xiv. and 396. *Maps and Illustrations. Presented by Dr. J. C. Branner.*

United States—Census. **Hunt.**

Census Reports. Vol. ii. Twelfth Census of the United States, taken in the year 1900. William R. Merriam, Director. Population. Part ii. Prepared under the supervision of William C. Hunt, Chief Statistician for Population (pp. ccxxiv. and 754). Ditto, Vols. v. and vi. Agriculture, Parts i. and ii. Farms, Live Stock and Animal Products (pp. ccxxxvi. and 768). Crops and Irrigation (pp. 880). Ditto, vols. vii.–ix. Manufactures, Parts i.–iii. United States by Industries (pp. ccxlii. and 698). States and Territories (pp. x. and 1102). Special Reports on Selected Industries (pp. xxiv. and 1120). Washington: U.S. Census Office, 1902. Size 12 × 9½. *Maps and Diagrams. Presented by the Director of the Census.*

United States—Education. ———

Board of Education. Special Reports on Educational Subjects. Vols. 10 and 11. Education in the United States of America. London: Eyre & Spottiswoode, 1902. Size 9½ × 6, pp. (vol. 10) vi. and 526; (vol. 11) vi. and 612. *Price* (*vol.* 10) 2*s.* 3*d.*; (*vol.* 11.) 2*s.* 6*d.*

United States—Geodesy. **Schott.**

Treasury Department. U.S. Coast and Geodetic Survey. Special Publication, No. 7. Geodesy. The Eastern Oblique Arc of the United States and Osculating Spheroid. By Chas. A. Schott. Washington, 1902. Size 11½ × 9, pp. 394. *Maps, Diagrams, and Illustrations. Presented by the U.S. Treasury Department.*

United States—Geodesy. ———

Report of the Superintendent of the Coast and Geodetic Survey, showing the progress of the work from July 1, 1899, to June 30, 1900. Washington, 1901. Size 12 × 9½, pp. 724. *Maps and Illustrations. Presented by the U.S. Coast and Geodetic Survey.*

Ditto, July 1, 1900, to June 30, 1901, pp. 440.

United States—Geological Survey. **Warman.**

B.U.S. Geolog. Surv. No. 177, *Washington*, 1901, *pp.* 858.

Catalogue and Index of the Publications of the United States Survey, 1880–1901. By Philip Creveling Warman.

United States—Massachusetts. ———

Essex Institute Historical Collections **38** (1902): 225–256.

The Misery Islands, and what has happened there. *Map, Illustrations, and facsimiles.*

The Misery islands were much concerned in the history of early settlement.

United States—Minerals. **Hay.**

Department of the Interior. United States Geological Survey. Mineral Resources of the United States. Calendar Year 1900, David T. Hay, Chief of Division of Mining and Mineral Resources. Washington, 1901. Size 9 × 6, pp. 928. *Diagram. Presented by U.S. Department of Interior.*

United States—New York. ———

Report of the Board of Rapid Transit Railroad Commissioners for and in the City of New York up to December 31, 1901. Accompanied by Reports of the Chief Engineer, and of the Auditor. New York, 1902. Size 10½ × 7, pp. 300. *Plans. Presented by the Board of Rapid Transit Railroad Commissioners, New York.*

United States—Oilfields. **Adams.**

B.U.S. Geolog. Surv. No. 184, *Washington*, 1901, *pp.* 64.

Oil and Gas Fields of the Western Interior and Northern Texas Coal Measures, and of the Upper Cretaceous and Tertiary of the Western Gulf Coast. By George J. Adams. *Maps, Plates, and Diagrams.*

United States—Rocky Mountains. *National G. Mag.* **13** (1902): 361–372. **Chapman.**

Our Northern Rockies. By R. H. Chapman. *Illustrations.*

Deals chiefly with the Lewis and Clarke Timber Reserve in Montana, recently surveyed by the U.S. Geological Survey.

United States—Rocky Mountains. **Glass.**

Chinook Winds. By E. J. Glass. (Proceedings of the Second Convention of Weather Bureau Officials held at Milwaukee, Wis., August 27, 28, 29, 1901, pp. 41–43.) Washington, 1902. *Plate.*

United States—Sailing Directions. ———

Supplement, 1902, relating to Sailing Directions for the East Coast of the United States, 1899. (Corrected to August, 1902.) London, 1902. Size 9½ × 6, pp. 56. *Price* 8*d. Presented by the Hydrographer, Admiralty.*

United States—Surveys. **Wilson and Others.**

B.U.S. Geolog. Surv. No. 185, *Washington*, 1901, *pp.* 220.

Results of Spirit Levelling, fiscal year 1900–01. By H. M. Wilson, J. H. Renshawe, E. M. Douglas, and R. M. Goode.

United States—Texas. *B.U.S. Geol. Surv. No.* 194, *Washington*, 1902, *pp.* 52. **Baker.**

The North-West Boundary of Texas. By Marcus Baker. *Maps and Diagrams.*

This will be noticed in the Monthly Record.

United States—Texas. *B.U.S. Geol. Surv. No.* 190, *Washington*, 1902, *pp.* 162. **Gannett.**

A Gazetteer of Texas. By Henry Gannett. *Maps.*

Opens with a valuable monograph on the State, the various distributions in which are illustrated by maps.

United States—Texas. *B.U.S. Geol. Surv. No.* 178, *Washington*, 1901, *pp.* 16. **Weed.**

The El Paso tin deposits. By Walter Harvey Weed. *Maps and Diagrams.*

These deposits occur on the east flank of the Franklin mountains, in the extreme western corner of Texas.

CENTRAL AND SOUTH AMERICA.

Argentine Republic. *Rev. Museo La Plata* **10** (1902): 257–264. **Quevedo.**

Las ruinas de Pajanco y Tuscamayo entre Siján y Pomán. Por Samuel A. Lafone Quevedo. *With Plate.*

Argentine Republic. ———

Ministerio de Obras Publicas de la República Argentina. Memoria al Honorable Congress. 1° Enero 1898–31 Julio 1899. Segunda Edicion. Buenos Aires, 1899. Size 10½ × 7, pp. 208. *Map and Diagrams.*

Ditto. (Segunda Memoria.) Buenos Aires, 1901. Size 10½ × 7, pp. 396. *Maps, Plans, and Diagrams. Presented by Dr. F. P. Moreno.*

Argentine Republic. ——

República Argentina. Ministerio de Obras Publicas. Inspección General de Navegación y Puertos. Concurso para la Construcción y Explotación de un Puerto Comercial en la cuidad del Rosario. Documentos Preliminares. Anexos A, B–B–X, C, & Indices y Tabla Analítica. 12 vols. Buenos Aires. G. Kraft, 1900. Size 10½ × 7. *Maps, Plans, etc. Presented by Dr. F. P. Moreno.*

Barbados. *Geolog. Mag.* **9** (1902): 550–554. **Harrison and Jukes-Browne.**

The Geology of Barbados. By Prof. J. B. Harrison, C.M.G., and A. J. Jukes-Browne.

Brazil. **Funke.**

Aus Deutsch-Brasilien. Bilder aus dem Leben der Deutschen im Staate Rio Grande do Sul von Alfred Funke. Leipzig: B. G. Teubner, 1902. Size 10 × 7, pp. viii. and 288. *Map and Illustrations. Price* 8*s.*

Dominica. **Bell.**

Dominica. Report on the Caribs of Dominica. Colonial Reports, Miscellaneous, No. 21, 1902. Size 10 × 6, pp. 16. *Map. Price* 2*d.*

Dutch Guiana. *Tijds. K. Ned. Aard. Genoots. Amsterdam* **19** (1902): 695–852. **Bakhuis.**

Verslag der Coppename-expeditie. Door L. A. Bakhuis. *With Map and Illustrations.*

This was noticed in the December number (vol. xx. p. 656). The map is on the scale of 1 : 200,000.

Ecuador. *Rev. G.* **26** (1902): 220–228. **Bourgeois.**

La Republique de l'Équateur. Ses conditions économiques, ses ressources et son avenir. Par Commandant R. Bourgeois.

Patagonia. **Prichard.**

Through the Heart of Patagonia. By H. Hesketh Prichard. London: W. Heinemann, 1902. Size 11 × 7½, pp. xvi. and 346. *Maps, Plates (Coloured and Photogravure), and Illustrations. Price* 21*s. net. Presented by the Publisher.*

This has been noticed elsewhere (vol. xx. p. 644).

Peru. ——

Guide du Perou pour Capitalistes et Emigrants. Lima, 1902. Size 7½ × 5½, pp. xiii. and (48). *Maps and Illustrations.*

Peru. *B.S.G. Lima* **10** (1900): 197–207. ——

De Quilca á Puno. Por Pentland. *With Map and Diagram.*

Peru. ——

El Perú para la Immigración. Región del Ucayali. Size 8 × 5½, pp. 20. *Map and Illustrations. Presented by the Peruvian Chargé d'Affaires.*

Peru. **Vanderghem and Others.**

Rapports présentés au Ministre de l'Agriculture et des Travaux publics du Pérou sur divers voyages entrepris dans quelques régions de la République par MM. les ingenieurs agronomes G. Vanderghem, H. van Hoorde, J. Michel, V. Marie et le Médecin-Vétérinaire A. Declerq. 1902. Size 7½ × 5½, pp. iv. and 214. *Maps and Illustrations. Presented by the Peruvian Chargé d'Affaires.*

Deals chiefly with the economic resources of various parts of Peru.

South America. **Fountain.**

The Great Mountains and Forests of South America. By Paul Fountain. London, etc.: Longmans, Green & Co., 1902. Size 9 × 5½, pp. 306. *Portrait and Illustrations. Presented by the Publishers.*

South America—Andes. **Burckhardt**

Anales del Museo de La Plata. Materiales para la Historia del Continente Sud-Americano. Sección Geológica y Mineralógica. III. Coupe Géologique de la Cordillère entre Las Lajas et Curacautin par le Dr. Carl Burckhardt. La Plata, 1900. Size 14½ × 11, pp. 102. *Maps, Diagrams, and Illustrations. Presented by Dr. Moreno.*

West Indies. *Ann. Hydrographie* **30** (1902): 429–436. **Schott.**

Ozeanographische Beobachtungen während einer Reise nach den westindischen Gewässern. Von Dr. G. Schott.

West Indies—Cuba. *B.U.S. Geol. Surv. No.* 192, *Washington*, 1902, *pp.* 114. **Gannett.**

A Gazetteer of Cuba. By Henry Gannett. *Maps.*

The gazetteer proper is preceded by a useful sketch of the geography, resources, climate, population, etc., of Cuba.

West Indies—Martinique. *Tour du Monde* **8** (1902): 397–408. ——

La Catastrophe de la Martinique. *Map and Illustrations.*

West Indies—Martinique. *Fortnightly Rev.* **72** (1902): 469–479. **Heilprin.**

Mont Pelée in its Might. By Prof. Angelo Heilprin.

Prof. Heilprin ascended to the crater of Mont Pelée in May last, while the volcanic forces were still in a state of disturbance.

West Indies—Martinique. **Lacroix, Rollet de l'Isle and Giraud.**

C. Rd. **135** (1902): 377–391, 419–431.

Sur l'éruption de la Martinique. Note de MM. A. Lacroix, Rollet de l'Isle et Giraud.

West Indies—Martinique. **Lacroix, Rollet de l'Isle and Giraud.**

Rev. Scientifique **18** (1902): 327–333, 390–396.

L'éruption de la Martinique. Rapport de MM. A. Lacroix, Rollet de l'Isle et Giraud. Ditto, Deuxième Rapport.

West Indies—Martinique and St. Vincent. **Hovey.**

Martinique and St. Vincent: a Preliminary Report upon the Eruptions of 1902. By Edmund Otis Hovey. (Author's Edition, extracted from Bulletin of the American Museum of Natural History, vol. xvi., article xxvi., pp. 333–372.) New York, 1902. Size 10 × 6½. *Maps and Plates.*

This was noticed in the December number (p. 638).

West Indies—St. Vincent. **Huggins.**

An Account of the Eruptions of the Saint Vincent Soufrière, with Woodcuts. By P. Foster Huggins. Printed at the *Times* Printing Office, Saint Vincent. [1902.] Size 7 × 5, pp. 32.

West Indies—St. Vincent and Martinique. ——

West Indies. Correspondence relating to the Volcanic Eruptions in St. Vincent and Martinique in May, 1902. *With Map and Appendix.* London: Eyre & Spottiswoode, 1902. Size 13½ × 8½, pp. xvi. and 100. *Price* 1*s.* 3*d.*

AUSTRALASIA AND PACIFIC ISLANDS.

Australia—Climate. *Queensland G.J.* **17** (1901–1902): 144–158. **Nelson.**

Anniversary Address to the Royal Geographical Society of Australasia, Queensland. By the Right Hon. Sir Hugh M. Nelson, K.C.M.G.

On the Climate of Australia.

Australia—Gums and Resins. **Maiden.**

J. and P.R.S. New South Wales **35** (1901): 161–212.

The Gums, Resins, and other Vegetable Exudations of Australia. By J. H. Maiden.

British New Guinea. *Queensland G.J.* **17** (1901–1902): 117–143. **Maguire.**

Impressions of a Year's Sojourn in British New Guinea. By H. R. Maguire.

Chatham Island. *T. and P. New Zealand I.* **34** (1901): 243–325. **Cockayne.**

A Short Account of the Plant-covering of Chatham Island. By L. Cockayne. *With Map and Plates.*

Santa Cruz Islands. *Records Australian Museum* **4** (1902): 289–291. **Etheridge.**

The Tavau, or Coil Feather currency of Santa Cruz Island, Santa Cruz Group. By R. Etheridge, jun.

Society Islands—Tahiti. *Tour du Monde* **8** (1902): 481–492. **Myrica.**

Tahiti—Notes et Impressions. Par M. Pierre de Myrica. *Map and Illustrations.*

South Australia—Discovery. ——

The Flinders Centenary. Incidents of an Historic Voyage. Reprinted from the *Register*, 1902. Adelaide, 1902. Size 8½ × 5½, pp. 18. *Illustrations.*

Tasmania. *P.R.S. Victoria* **15** (1902): 28–35. **Kitson.**

On the Occurrence of Glacial Beds at Wynyard, near Table Cape, Tasmania. By A. E. Kitson. *With Map.*

Victoria.

Statistical Register of the Colony of Victoria, etc. 1900. Compiled from Official Records in the Office of the Government Statist. Melbourne, [not dated]. Size 12½ × 8, pp. [698] and 66.

Western Australia—Calvert Expedition.

Western Australia. Journal of the Calvert Scientific Exploring Expedition, 1896-1897. Perth, 1902. Size 13½ × 8½, pp. 62. *Map and Illustrations. Presented by the Surveyor-General.*

A reprint of the journal kept from day to day, apparently by the leader, Mr. L. A. Wells. No explanation is given of the delay which has occurred in its publication. The map shows the route on the scale of 24 miles to the inch.

POLAR REGIONS.

Antarctic. **Bellingshausen.**

F. von Bellingshausens Forschungsfahrten im Südlichen Eismeer. 1819-1821. Auf Grund des russischen Originalwerks, herausgegeben vom Verein für Erdkunde zu Dresden. Leipzig: S. Hirzel, 1902. Size 9 × 6, pp. v. and 204. *Price* 5*s.*

Arctic. **Abruzzi, Cagni, and Molinelli.**

S. A. R. Luigi Amedeo di Savoia, Duca degli Abruzzi, U. Cagni, A. Cavalli Molinelli. La "Stella Polare" nel Mare Artico. 1899-1900. Milan: U. Hoepli, 1903 (1902). Size 10 × 7, pp. xii. and 592. *Maps, Plates, and Illustrations. Presented by the Duke of the Abruzzi.*

Arctic—Novaya Zemlya. **Moriak.**

A travers le Monde, Tour du Monde **8** (1902): 365-366.

L'Expédition du Capitaine russe Varnek à la Nouvelle-Zemble et à la Mer de Kara. Par M. Moriak. *With Map.*

Arctic Ocean. *P. American Philosoph. S.* **41** (1902): 154-161. **Bryant.**

Drift Casks in the Arctic Ocean. By Henry G. Bryant.

Arctic—Smith Sound. *Petermanns M.* **48** (1902): 195-201. **Stein.**

Geographische Nomenklatur bei den Eskimos des Smith-Sundes. Von Dr. Robert Stein. *With Map.*

Arctic—Russian Expedition. *Z. Ges. Erdk. Berlin* (1902): 630-634. **Toll.**

Von der Russischen Polar-Expedition, Berichte des Leiters der Expedition Baron Eduard Toll. 2. Kurzer Bericht für das Jahr 1901.

Arctic—Russian Expedition. *Petermanns M.* **48** (1902): 179-184. **Toll.**

Russische Polar-Expedition unter Leitung von Baron Ed. Toll. Bericht über die Tätigkeit und Verlauf der Expedition im Jahre 1901. Von Eduard von Toll.

Cf. article in *Journal* for August, 1902 (p. 216).

Spitsbergen. *B.G. Hist. et Descriptive* (1901): 32-62. **Hamy.**

Une Croisière française à la Côte Nord du Spitzberg en 1693. Par E. T. Hamy. *With Map.* [See note at p. 85, *ante*.]

MATHEMATICAL GEOGRAPHY.

Astronomy.

Connaissance des Temps ou des Mouvements Célestes, pour le Méridien de Paris, à l'usage des Astronomes et des Navigateurs, pour l'an 1905, publiée par le Bureau des Longitudes. Paris: Gauthier Villars, 1902. Size 9½ × 6½, pp. viii., 814, and 110. *Diagrams.*

Cartography. **Brunker.**

Notes on Maps and Map-reading for the guidance of Majors preparing for the "Tactical Fitness" Examination; and for Officers in instructing their N.C. Officers and men. By Lieut.-Colonel H. M. E. Brunker. London: W. Clowes & Sons, Ltd., 1902. Size 7 × 4, pp. vi. and 52. *Illustrations. Presented by the Publishers.*

Cartography. **Morrison.**

Maps: their Uses and Construction. A short popular treatise on the advantages and defects of Maps on various projections, followed by an outline of the principles involved in their construction. By G. James Morrison. Second Edition. Revised

and Enlarged. London: Edward Stanford, 1902. Size 8 × 5, pp. xii. and 152. *Diagrams. Price 5s. net. Presented by the Author.*

Most of the suggestions made in the review of the first edition (*Journal*, vol. xviii. p. 528) have been adopted in this edition.

PHYSICAL AND BIOLOGICAL GEOGRAPHY.

Earthquakes.

Kaiserl. Akademie der Wissenschaften in Wien. Mittheilungen der Erdbeben-Commission der Kaiserlichen Akademie der Wissenschaften in Wien. Neue Folge Nos. 1–8. Wien, 1901–1902. Size 9½ × 6½, pp. 64, 114, 56, 24, 52, 56, 116, and 36. *Maps, Plate, and Diagram.*

Geological History. **Ackroyd.**

P. Yorkshire Geolog. and Polytechnic S. **14** (1902): 401–421.

On the Circulation of Salt and its Bearing on Geological Problems, more particularly that of the Geological Age of the Earth. By William Ackroyd. *With Diagrams.*

Geomorphology. **Neuber.**

Wissenschaftliche Charakteristik und Terminologie der Bodengestalten der Erdoberfläche. Von August Neuber. Wien und Leipzig: W. Braumüller, 1901. Size 10 × 6½, pp. xii. and 648. *Presented by the Publisher.*

Oceanography—Red Sea. *Sitzb. K.A.W. Wien* **110** (1901) (*Abth. I.*): 249–258. **Fuchs.**

Ueber den Charakter der Tiefseefauna des Rothen Meeres auf Grund der von den österreichischen Tiefsee-Expedition gewonnenen Ausbeute. Von Theodor. Fuchs.

Physical Geography. **Gilbert and Brigham.**

Twentieth Century Text-books. An Introduction to Physical Geography. By Grove Karl Gilbert and Albert Perry Brigham. London: Hirschfeld Brothers, 1902. Size 8 × 5, pp. xvi. and 380. *Maps and Illustrations. Price 5s. net. Presented by the Publishers.*

Physical Geography. **Suess.**

La Face de la Terre. (Das Antlitz der Erde.) Par Ed. Suess. Traduit avec l'Autorisation de l'Auteur par Emmanuel de Margerie. Tome iii. (1re Partie). Paris: Armand Colin, 1902. Size 10 × 6½, pp. xii. and 530. *Maps and Illustrations. Price 15 fr. Presented by the Publishers.*

This will be specially noticed.

Rivers. **Herrmann.**

Forecasting for Rivers of Small Drainage Area, especially those of North Carolina. By C. F. von Herrmann. (Proceedings of the Second Convention of Weather Bureau Officials held at Milwaukee, Wis., August 27, 28, 29, 1901. pp. 158–167.) Washington, 1902.

Discusses the influence on the flow of rivers of geological, topographical, and meteorological conditions.

Rivers. *National G. Mag.* **13** (1902): 373–384. **Jefferson.**

Limiting Width of Meander Belts. By Prof. Mark S. W. Jefferson. *Diagrams.*

Discussed chiefly from a mathematical point of view.

River Basins. *B. Union G. Nord de la France* **23** (1901): 195–208. **Conrad.**

Essai d'une théorie des bassins fluviaux et de l'érosion des masses continentales. Par H. Conrad.

The author attempts a more precise definition of river-basins than is generally given, paying attention to the flow of underground as well as sub-aërial waters.

River Curves. *Geolog. Mag.* **9** (1902): 450–455. **Callaway.**

On a Cause of River Curves. By C. Callaway, D.SC. *With Diagrams.*

The influence of the junction of tributaries is considered of importance in the development of curves.

Volcanoes. *Rev. Scientifique* **18** (1902): 296–304. **Taquin.**

A propos de la théorie des volcans. Par A. Taquin.

ANTHROPOGEOGRAPHY AND HISTORICAL GEOGRAPHY.

Historical—Toscanelli. **Gravier.**

La Lettre et la Carte de Toscanelli à Fernam Martins et à Christophe Colomb d'après Henry Vignaud. Par M. Gabriel Gravier. (From the *B.S. Normande G.* 1902. Rouen: E. Cagniard, 1902. Size 9 × 7, pp. 24. *Price* 4*s.*

History. **Brandt, Schurtz, etc.**

Weltgeschichte. Zweiter Band. Ostasien und Ozeanien. Der Indische Ozean. Von Max von Brandt, Dr. Heinrich Schurtz, Prof. Dr. Karl Weule, and Prof. Dr. Emil Schmidt. Leipzig and Wein: Bibliographisches. Institut., 1902. Size 10½ × 7, pp. xvi. and 638. *Maps and Plates.*

BIOGRAPHY.

Chalmers. **Lovett.**

James Chalmers. His Autobiography and Letters. By Richard Lovett, M.A. Third Impression. London: The Religious Tract Society, 1902. Size 9 × 5½, pp. 512. *Maps and Portraits. Price* 7*s.* 6*d. net. Presented by the Religious Tract Society.* [To be reviewed.]

Frobisher. *Hull Lit. Club Mag.* **2** (1901–1902): 217–219. **Blyth.**

Sir Martin Frobisher: a Yorkshire Elizabethan Seaman. By Robert Blyth, jun.

Hall and Foxe. *Hull Lit. Club Mag.* **2** (1901–1902): 239–241. **Dixon.**

The Records relating to Masters James Hall and Luke Foxe, Hull Seamen. By Ronald Dixon.

Parmentier. **Gravier.**

Notice sur Jean Parmentier; Navigateur Dieppois (1494–1530). Par M. Gabriel Gravier. Rouen: E. Cagniard, 1902. Size 9 × 7, pp. 14. *Price* 4*s.*

Sabine. *Terrestrial Magnetism* **7** (1902): 131–140. ———

Biographical Sketch of General Sir Edward Sabine, F.R.S., K.C.B. *With Portrait.*

Scheuchzer. **Hoeherl.**

Johann Jacob Scheuchzer, der Begründer der physischen Geographie des Hochgebirges. Von Dr. Franz Xaver Hoeherl. (Münchener geographische Studien, herausgegeben von Siegmund Günther. Zehntes Stück.) München: T. Ackermann, 1901. Size 9 × 6, pp. viii. and 108.

Scheuchzer (born at Zürich, August 2, 1672) was the first to study scientifically, not only the outer form, but the structure, meteorology, glaciers, etc., of the Alps.

GENERAL.

Almanac. **Olsen.**

The Fisherman's Nautical Almanack and Tide Tables. A Directory of British and Foreign Fishing Vessels, Steamers, etc. By O. T. Olsen. 27th Year, 1903. Size 7 × 5, pp. xxxviii. and 514. *Price* 1*s. Presented by the Author.*

Antwerp Exhibition. ———

Anvers—Mai-Juillet 1902. Catalogue de l'Exposition Cartographique, Ethnographique et Maritime . . . organisée, par la Société Royale de Géographie d'Anvers. Anvers, 1902. Size 8½ × 6, pp. xxxii. and 368. *Plates.*

Atlantis. *Geolog. Mag.* **9** (1902): 455–456. **Scharff.**

Some Remarks on the Atlantis Problem. By R. F. Scharff, PH.D.

Bibliography—Geology. ———

Geological Literature added to the Geological Society's Library during the Year ended December 31, 1901. Compiled by the Assistant-Librarian and edited by the Assistant-Secretary. London: Geological Society, 1902. Size 9 × 5½, pp. 196. *Price* 2*s. Presented by the Geological Society.*

British Association. ———

The British Association at Belfast. Special Report. (The *Irish Naturalist*, November, 1902, pp. 253–310.) Dublin: Eason & Son. Size 8½ × 5½. *Presented by the Editors.*

Catalogue.

Catalogue of the Library of the Zoological Society of London. Fifth Edition. London: Taylor and Francis, 1902. Size 9 × 5½, pp. 856. *Presented by the Zoological Society.*

The Library now contains about 25,500 volumes, including many of geographical interest.

Colonization. **Chailley-Bert.**

Les Compagnies de Colonisation sous l'ancien régime. Par Joseph Chailley-Bert. Paris: Armand Colin et Cie., 1898. Size 7½ × 4½, pp. 192. *Price* 2*s.* 3*d.*

On the system of "chartered companies" in former days in the principal European countries.

Eastern Asia and Africa. **Madrolle.**

De Marseille à Canton. Guide du Voyageur. Par Cl. Madrolle. Publié par le Comité de l'Asie Française. Indo-Chine, Canal de Suez, Djibouti et Harar, Indes, Ceylan, Siam, Chine Meridionale. Paris: Comité Asie Française, 1902. Size 7 × 4½, pp. viii., vi., 133, xiii., and 186. *Maps and Plans. Price* 18 *fr. Presented by the Publishers.*

This is useful as the first attempt to provide the general traveller with a handy guide-book to the French possessions in the Far East. The bulk of the volume is devoted to Indo-China, but other countries of Eastern Asia are briefly touched upon.

Education—Map-drawing. **Scanlan.**

Memory Map-drawing. By a Professional Teacher. (R. G. Scanlan, Pialba State School, Queensland.) Halifax: Blatchford Brothers, 1902. Size 9½ × 7½, pp. 28. *Diagram and Maps. Presented by the Publishers.*

Exploration. **Hugues.**

Manuali Hoepli. L. Hugues. Cronologia delle Scoperte e delle Esplorazioni Geografiche, dall' anno 1492 a tutto il secolo xix. Milan: Ulrico Hoepli, 1903. Size 6 × 4, pp. viii. and 488. *Price* 4.50 *lire. Presented by the Publishers.*

Geography. **Bosworth.**

Macmillan's Short Geography of the World. A New Handbook for Teachers and Students. By George F. Bosworth. London: Macmillan & Co., 1902. Size 7 × 4½, pp. vi. and 198. *Price* 1*s.* 6*d. Maps and Illustrations. Presented by the Publishers.*

This is little more than a summary of geographical facts, slight regard being paid to the relations of cause and effect, and it therefore possesses little educational value.

Malaria. **Stephens and Christophers.**

Royal Society. Reports to the Malaria Committee. Seventh Series. Reports from Messrs. Stephens and Christophers, India. London: Harrison & Sons, 1902. Size 8½ × 5½, pp. 52. *Illustrations. Price* 3*s. Presented by the Royal Society.*

Medical Geography. **Sedgwick and Winslow.**

Mem. American A. Arts. and Sci. **12** (1902): 521–577.

Statistical Studies on the Seasonal Prevalence of Typhoid Fever in Various Countries and its Relation to Seasonal Temperature. By William T. Sedgwick, PH.D., and Charles-Edward A. Winslow, S.M. *With Diagrams.*

Mountaineering. **Collie.**

Climbing on the Himalaya and other Mountain Ranges. By J. Norman Collie. Edinburgh: David Douglas, 1902. Size 9 × 5½, pp. xii. and 316. *Maps and Illustrations. Presented by the Publishers.*

This will be specially noticed.

Mountain-sickness. *Alpine J.* **21** (1902): 161–179. **Hepburn.**

Some Reasons why the Science of Altitude-illness is still in its Infancy. By Dr. M. L. Hepburn.

Nature Study. *Scottish G. Mag.* **18** (1902): 525–536. **Geddes.**

Nature Study and Geographical Education. By Prof. Patrick Geddes.

Place-names. *B.S.G. Genève* **41** (1902): 97–108. **Ottramare.**

Noms de lieux et de peuples. Par M. le Prof. Paul Ottramare.

Sailing Directions. **Maclear.**

Eastern Archipelago. Part i. (Eastern Part) comprising the Philippines, Sulu Sea, Sulu Archipelago, N.E. Coast of Borneo, Celebes Sea, N.E. Coast of Celebes.

Molucca and Gillolo Passages, Banda and Arafura Seas, N.W. and West Coasts of New Guinea, and North Coast of Australia. Compiled from various sources by Captain J. P. Maclear. London: Eyre & Spottiswoode, 1902. Size 9½ × 6, pp. xxxii. and 632. *Map.* *Price* 4*s.* *Presented by the Hydrographer, Admiralty.*

NEW MAPS.

By E. A. REEVES, *Map Curator*, R.G.S.

EUROPE.

Albania. **Institut Géographique de Bruxelles.**

Albania. Scale 1 : 500,000 or 7·8 stat. miles to an inch. Université Nouvelle. Institut Géographique de Bruxelles, 1902.

An orographical map of Albania, showing height of land by means of five different tints of brown, ranging from 100 to over 2000 metres. It is somewhat diagramatic in style, and few names are given. Two insets appear in the left-hand corner of the map, illustrating the geology and climatic conditions of the country.

England and Wales. **Ordnance Survey.**

ORDNANCE SURVEY OF ENGLAND AND WALES:—Revised sheets published by the Director-General of the Ordnance Survey, Southampton, from November 1 to 29, 1902.

1 inch:—

With hills in brown or black, 75, 114 (engraved). 1*s.* *each.*
Printed in colours: 96 and part of 83 (combined). 1*s.* 6*d.* 116 and part of 129 (combined), 121, 151, 152, 164. 1*s.* *each.*

6-inch—County Maps:—

Dorsetshire, 7 N.W., 13 N.W., S.W., 31 S.E., 32 S.E., 40 N.E., 41 N.E., 44 S.W., S.E., 48 N.E., S.E., 49 N.W., 56 S.E. **Gloucestershire,** 13 N.E. **Montgomeryshire,** 4 N.E., S.E., 5 S.W., S.E., 6 S.E., 8 N.W., N.E., 9 S.W., S.E., 10 N.W., S.W., S.E., 11 N.W., S.W., 13 N.E., S.W., 14 N.W., N.E., S.W., S.E., 15 N.E., S.W., S.E., 17 N.W., 20 S.E., 21 N.W., N.E., S.W. **Shropshire,** 8 N.E., 11 S.E., 12 S.E., 13 N.E., 14 N.W., S.W., 16 N.W., 18 S.E., 19 S.W., 22 N.E., 23 S.E., 26 N.W., N.E., S.W., 28 N.W., N.E., 29 N.W., S.W., S.E., 30 N.W., N.E., 33 N.W., N.E., S.W., 35 N.W., N.E., 36 N.W. **Somersetshire,** 85 N.W. **Staffordshire,** 43 N.E., 46 S.W., 56 N.E. **Worcestershire,** 56 N.E. 1*s.* *each.*

25-inch—County Maps:—

Cambridgeshire, XXIII. 10; XXVII. 9, 13; XXXI. 1, 5; XXXIII. 8; XXXIV. 10, 16; XXXV. 7, 12, 15, 16; XXXVI. 1, 2, 5, 6; XXXIX. 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16; XL. 3, 6, 8; XLI. 1, 3, 4, 5, 6, 7, 9, 10, 13, 14; XLII. 13; XLVI. 1, 4; XLVIII. 1, 2, 6, 9; LV. 1, 2, 3, 5, 11, 12. **Dorsetshire,** XXI. 7, 8, 9, 11, 12, 13; XXX. 1, 4, 6, 8, 10, 11, 12, 13, 14, 16; XXXVIII. 2, 3, 6, 13, 14; XLV. 2, 3, 8, 12; XLVI. 1, 9, 10, 11, 12, 14; LII. 2, 12; LIII. 6; LIV. 6, 12. **Gloucestershire,** XXXIV. 16; XLIV. 7; XLVI. 10, 11, 12, 14, 15, 16; LIV. 2, 3, 4, 6, 7, 11, 12, 14, 15; LVI. 15, 16; LXII. 3, 4, 7, 8, 11, 12, 14, 15, 16; LXIII. 6, 7; LXIV. 10; LXIX. 10; LXXIII. 14, 16. **Montgomeryshire,** XXXI. 2; XXXVII. 4, 7; XLVII. 3, 12, 14; XLVIII. 3, 4, 5, 6; LI. 3, 4, 7, 8, 10, 11. **Radnorshire,** VII. 4, 7, 8, 10, 11. **Shropshire,** XXXVI. 15; XLIV. 1; XLVII. 2, 6, 13; XLVIII. 1, 3, 5, 6, 7, 8, 13; L. 14, 15, 16; LI. 13, 15, 16; LII. 6, 12, 13; LIII. 4; LV. 1, 6, 10; LVII. 2, 3, 4, 6, 7, 8, 10, 12; LIX. 4, 6, 7, 8, 12. **Somersetshire,** LXXXVII. 11, 12, 15, 16. **Staffordshire,** LXII. 1, 5, 7; LXIII. 5, 6, 7, 8; LXIV. 5; LXV. 3, 5, 7; LXXIV. 3, 4. **Suffolk.** XXX. 12, 16; XXXI. 5; XLI. 4. **Warwickshire,** V. 3, 5, 7. **Worcestershire,** VIII. 3, 4, 7, 11, 15, 16; XIII. 12; XIV. 4. **Yorkshire.** CCLXXXIV. 14, 15, 16; CCLXXXV. 11, 12, 13, 14, 15; CCXC. 13, 15; CCXCI. 5, 10, 14; CCXCII. 9; CCXCVI. 5; CCXCIX. 4. 3*s.* *each.*

England and Wales. **Geological Survey.**

Maps (1-inch). New Series (colour-printed). Solid Edition, 232, 249. 1*s.* 6*d.* *each.*

(*E. Stanford, London Agent.*)

Rome. **Huelsen.**

Romæ veteris tabula in usum scholarum descripta. With inset plans, (1) Urbis Incrementa Regionatim descripta; (2) Urbis pars Media duplici Maioris Tabulæ Modulo descripta. Christian Huelsen. Scale 1:4,250 or 0·06 stat. mile to an inch. Four sheets. Berlin: Dietrich Reimer (Ernst Vohsen), 1901. *Price, unmounted in paper cover, 9 marks.*

This is a large wall-plan of ancient Rome, prepared specially for the use of schools. It is clearly executed in a bold style, and printed in colours.

ASIA.

Asia. **Service Géographique de l'Armée. Paris.**

Asie. Scale 1: 1,000,000 or 15·8 stat. miles to an inch. Sheets: 20 N., 108 E., Hué; 24 N., 114 E., Canton. Service Géographique de l'Armée. Paris, 1900–1901.

These two sheets form part of the large map of Asia, on the scale of 1: 1,000,000, which has been commenced by the Service Géographique de l'Armée, Paris. They are printed in colours, and contain the results of survey work up to 1900.

Asiatic Russia. **Toll.**

Die Aufnahme der Taimyr-Bai 1900-01 durch Baron E. Toll. Scale 1: 3,500,000 or 55·2 stat. miles to an inch. *Petermanns Geographische Mitteilungen*, Jahrgang 1902. Gotha: Justus Perthes. *Presented by the Publisher.*

Indian Government Surveys. **Surveyor-General of India.**

Indian Atlas, 4 miles to an inch. Sheets: 20 N.E., parts of Jodhpur (Native State, Rajputana Agency), additions up to 1901, 1902. 40 S.W., parts of districts Belgaum, Ratnágiri, and Sátara, Native States of Kolhápur and Southern Maratha and Sátára Agencies (Bombay Presidency), 1901. 51 S.W., parts of Native States of Gwalior (C.I. Agency), Bundi, Tonk, Jaipur, Kotah, and Jhalawar (Rajputana Agency), with additions to 1899, 1901. 60 N.W., parts of districts Mysore, Hassan, Kadur, and Túmkúr (Mysore State), additions to 1896, 1901. 64 S.W., parts of district Kángra (Punjab), of Rukshu (Kashmir), and Great Tibet, additions to 1899. 69 S.E., parts of districts Hamírpur, Fatehpur, and Bánda (United Provinces of Agra and Oudh), and Native State of Bundelkhand (C.I. Agency), additions to 1899. 78 N.E., Madras district and parts of North Arcot, Nellore, and Chingleput district (Madras Presidency), additions to railways up to 1899. 105 S.W., parts of districts Bilaspur and Sambalpur (Central Provinces); of district Ránchi and Tributary States Sarguja, Udaipur, Gángpur, and Jashpur (Chota Nágpur), additions to 1899, 1901. 124 S.W., parts of districts Kámrúp, Darrang, Gáro hills, Goálpára, and Khási and Jaintia hills (Assam), additions to 1901, 1902. 125 S.W., parts of districts Mymensingh (Bengal) and Sylhet (Assam), additions to 1901, 1902. 54, parts of districts Hoshangabad, Nimár, Wardha and Betul (Central Provinces), Amraoti, Akola, Buldána, and Ellichpur (Berar), Khandesh (Bombay Presidency), and of Native State Indore (C.I. Agency), additions to 1899.—Burma and adjacent countries, scale 32 miles to an inch, 2 sheets, second edition, with additions to boundaries and railways up to December, 1901, 1902.—The Central India Agency, scale 16 miles to an inch, 2 sheets and index, additions and corrections to 1901.—The North-Western Provinces and Oudh, showing the districts and states under the jurisdiction of the Lieutenant-Governor and Chief Commissioner, scale 16 miles to an inch, 2 sheets and index, with additions and corrections to 1901.—Lower Provinces Revenue Survey, 1 mile to an inch, district Monghyr, Seasons 1836–38 and 1845–47. Sheet 15 (second edition), with additions to boundaries, 1897, 1901, district Purneah. Sheet 12, with additions to boundaries and railways, 1897, 1901.—District of Surat, 5 miles to an inch. 1902.—Assam Survey, 1 mile to an inch. Sheets (Preliminary Edition) 8 and 9. District Goálpára, Seasons 1895–98, 1901–1902; (Preliminary Edition) 18, district Kámrup, Season 1896–97, 1902; (Second Preliminary Edition) 38 and portion of 37, districts Kámrup and Darrang, Seasons 1885–86, 1890–91, and 1896–97, 1902; (Preliminary Edition) 49, district Darrang, Seasons 1886–87, and 1895–96, 1902; (Preliminary Edition) 52, districts Kámrup and Nowgong, Seasons 1887–88, 1890–91, and 1897–99, 1902; (Preliminary Edition) 62 and 63, district Nowgong, Seasons 1887–88, 1890–91, and 1897–98, 1902; (Preliminary Edition) 163, North Lushai hills, Seasons 1898–99, 1900, 1901.—Bengal Survey, 1 mile to an inch. Sheets: 111, districts Muzaffarpur and Champáran, Seasons 1893–96, 1902; (Preliminary Edition) 143, district Muzaffarpur, Seasons 1885–86 and 1893–95, 1901; 285 and portion of 308, district Hooghly, Seasons 1869–70,

1901.—Bombay Survey, 1 mile to an inch. Sheet 135, district Thána and Jawhár State, Seasons 1884–85, 1902.—Burma Survey, 1 mile to an inch. Sheets: 125 (142 Old Series), districts Bassein and Myaungmya, Seasons 1879–80, 1901; (Preliminary Edition) 190 (New Series), district Shwebo, Seasons 1892–96, 1901: 240 (New Series) districts Mandalay, Ruby Mines, Shwebo and Hsi Paw (North Shan States), Seasons 1890–91 and 1897–1900, 1901; (Preliminary Edition) 244 (262 Old Series), districts Sagaing, Kyaukse, Mandalay and Southern Shan States, Seasons 1889–90, 1891–92, and 1898–1900, 1902; 255 (273 Old Series), district Toungu, Seasons 1890–91–92, 1901; (Second Edition) 305 (324 Old Series), districts Pegu and Toungu, Seasons 1895–98, 1901; (Second Edition) 307 (326 Old Series), districts Pegu and Thâton, Seasons 1881–84 and 1894–97, 1901; (354 New Series), district Thâton, Season 1892–95, 1901: (Preliminary Edition) 435 (New Series), parts of South Hsenwi and Manglon States, Season 1899–1900, 1901; 436 (New Series), parts of Northern and Southern Shan States, Season 1899–1900, 1901.—Madras Survey, 1 mile to an inch. Sheet 74, part of district Túmkúr (Mysore), Season 1876–78, with additions to roads, canals, etc., up to 1896, 1901.—South-Eastern Frontier, 4 miles to an inch (Seventh Edition). Sheet: 4 s.w., Upper Burma, parts of districts Ruby mines, Schwebo, Sagaing, Mandalay, and of Northern Shan States, Seasons 1886–93, with additions and corrections up to December, 1900, 1902.—North-Western Province and Oudh Survey, 1 mile to an inch. Sheets: (Preliminary Edition) 70, district Shahjanpur, Seasons 1895–97, 1902; 85, district Budaun, Season 1877–78, corrections to boundary up to October, 1900, 1901; 168, districts Mírzapur and Jaunpur, Seasons 1877–81, and 1885–86, with additions and corrections to railways, etc., up to May, 1899, 1901; 195, districts Jaunpur, Ghazipur and Benares, Seasons 1879–84, with additions and corrections to railways and roads, etc., up to June, 1897, 1901; 214 and 52, parts of Gorakhpur (N.W. Provinces and Oudh) and Champáran (Bengal), Seasons 1885–87, 1892–93, and 1894–96, 1902.—Hyderabad Assigned districts, district of Ellichpur, 8 miles to an inch, 1901.—Assam, district Goálpára, 8 miles to an inch, 1901: district Sylhet, 8 miles to an inch, 1902.—Chart of Traverse, No. 20, party (Burma forest), 21 miles to an inch. Sheet 213 (New Series), Season 1893–94, 1902; Chart of Triangulation, No. 20 party (Burma), 2 miles to an inch. Sheets: 253 (New Series), Season 1891–93, 1902; 255 (New Series), Seasons 1885–92, 1902; 257 (New Series), Seasons 1894–96, 1902; 258 (New Series), Seasons, 1882–83–84, 1886–87, and 1895–96, 1902.

Indo-China. **Service Géographique de l'Indo-Chine.**

Carte de l'Indo-Chine. Scale 1 : 100,000 or 1·5 stat. miles to an inch. Sheets: Cap-Varella, Phan-Rang, Saigon, M'Sao, Da R'Lac, Dan-Kia, Dan-Kia (Ouest), Djirinh, Mi-Pou, Tam-Linh. Service Géographique de l'Indo-Chine, 1901–1902.

Indo-China. **Service Géographique de l'Indo-Chine.**

Environs de Saigon. Scale 1 : 20,000 or 0·31 stat. mile to an inch. 5 sheets. Service Géographique de l'Indo-Chine, 1900.

This forms one of a series of maps now being published of the environs of towns and important districts in French Indo-China, on comparatively large scales. It is based upon the surveys of French officers, and is clearly printed in colours.

AMERICA.

Canada. **Geological Survey.**

Geological Map of the Dominion of Canada (Western Sheet, No. 783). Scale 1 : 3,168,000 or 50 stat. miles to an inch. Geological Survey of Canada. Ottawa, 1901. *Presented by the Geological Survey of Canada.*

It is, of course, too early to expect anything like a complete geological map of the whole of the Dominion of Canada, as there are many areas concerning which very little is at present known. Still, the members of the Geological Survey have been most energetic in their investigations, and Dr. Bell, under whose superintendence the work is now carried on, has been able to produce a geological map which is a great advance on anything of the kind hitherto published. There are, of necessity, many generalizations, especially in the complicated mountain systems of northern British Columbia, the upper Yukon, and other little-known districts of the far north, which regions will be dealt with in a more complete manner later on. But even as it now appears, this map contains a vast amount of valuable information, a great deal of which was obtained by means of the expeditions despatched by the late director of the survey, Dr. G. M. Dawson. So far the western sheet only has appeared, but it is to be hoped that the eastern will soon follow.

Canada. **Surveyor-General's Office, Ottawa.**

Sectional Map of Canada. Scale 1 : 190,080 or 3 stat. miles to an inch. Moosomin Sheet (26), West of Principal Meridian. Revised to August 20, 1902. Yale Sheet (93), West of Sixth Meridian. Revised to September 25, 1902. Surveyor-General's Office, Ottawa, 1902. *Presented by the Surveyor-General of Canada.*

The district represented on No. 26, Moosomin sheet, is situated immediately to the west of the western boundary of the province of Manitoba, whilst No. 93, the Yale sheet, shows the lower course of the Fraser river, British Columbia, from just above Wellington bar to Sumass lake, as well as the line of the Canadian-Pacific Railway, which follows the river valley.

GENERAL.

World. **Bartholomew.**

The Twentieth Century Citizens' Atlas of the World, containing 156 pages of maps and plans, with an Index, a Gazetteer, and Geographical Statistics. Edited by J. G. Bartholomew, F.R.G.S. London: George Newnes, Ltd., 1902. *Price* 21*s.*

Although it is only about four years since the first edition of this atlas was published, yet during that comparatively short interval our geographical knowledge has considerably advanced in many parts of the world, and important changes have taken place in the territorial boundaries which have rendered a revised edition a necessity. The above is, however, far more than a corrected edition of the former work, for it has been considerably enlarged and improved by the addition of new maps, of which there are now altogether 156 sheets instead of 120 as before, and by the introduction of fresh letterpress, as well as a most useful index for reference, the omission of which was a great deficiency in the earlier edition. The "Descriptive Gazetteer of the World," which was previously given at the commencement, is still retained, in addition to the new index, and it now appears at the end of the atlas. The more important of the new maps are those devoted to physical geography, and among these may be mentioned the vegetation map of the World and Africa, maps of the World showing mean annual temperature, prevailing winds, and distribution of clouds, population and religious maps of the world, orohydrographical maps of Central Europe, United States, India, and several others. It is perhaps too much to expect that an atlas of this kind should be entirely free from errors, and considering the rapid strides that are being made in exploration and surveying in all parts of the world at the present time, it is almost impossible that the maps should be all up to date; but, taken as a whole, this is certainly a remarkably good and cheap atlas for general reference, and for this purpose deserves to become very popular. The maps are produced in Mr. Bartholomew's usual clear style, although they vary considerably in merit.

World. **St. Martin and Schrader.**

Atlas Universel de Géographie. Commencé par M. Vivien de St. Martin et continué par Fr. Schrader. Sheets: No. 3, Mappemonde; No. 19, Espagne et Portugal, Sud-Ouest. Paris: Librairie Hachette et Cie. *Price 2 fr. each sheet.*

Sheet No. 3 contains three maps of the world, the first of which, on the scale of 1 : 75,000,000, shows in hemispheres, heights of the land in six different tints from 200 to 4000 metres, and depths of water in six shades of blue. The effect would have been more satisfactory if, instead of different colours having been used to indicate the relief of the land, shades of one colour, such as burnt sienna, had been employed. There might also with advantage have been greater difference between the shades of blue indicating the depths of the ocean. The great ocean deeps might also have been more clearly brought out. The two other maps of the world on this sheet are on a much smaller scale, and consist of one, on an elliptical projection, showing zones of vegetation and ocean currents, and another, in hemispheres, showing annual rainfall and winds. Sheet No. 19 is the south-west sheet of a beautifully executed map of Spain and Portugal, on the scale of 1 : 1,250,000, of which only one sheet, the south-east, remains to be published. Altogether sixty-two sheets have now been published of the ninety of which the atlas will consist when finally completed, which at the present rate of issue will not be for years to come. A sheet of letterpress accompanies each map, giving the authorities consulted.

World. **Schott.**

Die Verteilung des Salzgehalts im Oberflachenwasser der Ozeane. Von Dr. Gerhard Schott, 1902. Scale 1 : 80,000,000 or 1262·6 stat. miles to an inch. *Petermanns Geographische Mitteilungen*, Jahrgang 1902, Taf. 19. Gotha: Justus Perthes. *Presented by the Publisher.*

CHARTS.

Admiralty Charts. **Hydrographic Department, Admiralty.**

Charts and Plans published by the Hydrographic Department, Admiralty, during September and October, 1902. *Presented by the Hydrographic Department, Admiralty.*

No.	Inches.	
3185 m	= 3·0	Scotland, west coast :—Loch Sunart. 2*s.* 6*d.*
3287 m	= 2·9	Ireland, north coast :—Entrance to Lough Foyle. 1*s.* 6*d.*
3300 m	= 6·0	Baltic sea :—Windau. 1*s.* 6*d.*
162 m	= 2·27 / 7·28	Black sea :—Novorossisk bay (Sujak). Novorossisk harbour. 1*s.* 6*d.*
3301 m	= 7·0	Africa, north coast :—Tenez road and harbour. 1*s.* 6*d.*
3305 m	= 5·75	Newfoundland, east coast, Bay Verte :—Coachman harbour. 1*s.* 6*d.*
3223 m	= 3·0	Newfoundland :—Sunday cove island to Thimble tickles. 2*s.* 6*d.*
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3290 m	= 3·63	Cuba, north coast :—Livisa and Cabonico bays. 2*s.* 6*d.*
3291 m	= 4·0	Cuba, north coast :—Port Tanamo. 1*s.* 6*d.*
3295 m	= 1·8 / 2·9	Plans on the east coast of South America :—Chubut river, Camarones bay. 1*s.* 6*d.*
745 m	= 0·5	India, west coast. Sheet VIII. :—Netrani to Mangalore. 2*s.* 6*d.*
71 m	= 0·25	Bay of Bengal :—Madras to Calimere point. 2*s.* 6*d.*
3299 m	= 3·0	China, north coast :—Shitau bay and approaches. 1*s.* 6*d.*
2423 m	= 0·25	Papua or New Guinea. Sheet III. :—Boigu island to Cape Blackwood. 2*s.* 6*d.*
10c. m	=	Arabian coast. Plan added :—Sur anchorage.
1472 m	=	Australia, south coast. Plan added :—Kumbanah bay.
2411 m	=	New Zealand. Plan added :—Entrance to Otago harbour.

(*J. D. Potter, Agent.*)

Charts Cancelled.

No.	Cancelled by	No.
2372 Windau. Plan on this chart.	New plan. Windau	3300
162 Novorossisk bay.	New plan. Novorossisk bay and harbour	162
1766 Tenez anchorage. Plan on this chart.	New plan. Tenez road and harbour	3301
428 Ports of Cabonico and Livisa. Plans on this sheet.	New plan. Livisa and Cabonico bays	3290
428 Port Tanamo. Plan on this sheet.	New plan. Port Tanamo	3291
745 India. Sheet VIII. Alvagudda to Mulki.	India. Sheet VIII. Netrani to Mangalore	745
1156 South-east promontory anchorage. Plan on this sheet.	New plan. Shitau bay and approaches	3299
1034 Kumbanah bay. Plan on this chart.	New plan. Kumbanah bay on sheet	2411

Charts that have received Important Corrections.

No. 2010, England, west coast :—Morecambe bay. 1191, England, east coast :—Flamborough head to Hartlepool. 1210, Ireland, south coast :—Berehaven. 3038, Norway :—Biörnsund to Kristiansund. 565, Iceland, western portion. 2733, Iceland :—Portland to Sudfells Jökel. 566, Iceland, eastern portion. 280, Newfoundland :—Notre Dame bay. 2857, East coast of United States :—Potomac river. 424, Cuba :—Port Matanzas. 2344, Gulf of Mexico :—Mobile bay. 550, South America, east coast :—Entrance of the river of Saõ Francisco. 1911, United States, west coast :—Approach to Juan de Fuca strait. 630, British Columbia :—Port Neville, Forward harbour. 759B, Madagascar :—Antongil bay to Ambatosoa. 1270, Korea :—Approaches to Chemulpo anchorage. Chemulpo anchorage. 1065, Korea :—Douglas inlet and Sir Harry Parkes sound. 1203, Japan :—Uraga harbour.

(*J. D. Potter, Agent.*)

North Atlantic Ocean and Mediterranean Sea. **Meteorological Office, London.**

Pilot Chart of the North Atlantic and Mediterranean for December, 1902. London: Meteorological Office. *Price 6d. Presented by the Meteorological Office, London.*

River Mersey. **Belam and Ashton.**

Chart of the River Mersey, from Rock Lighthouse to Eastham and Garston, 1901. Scale 1500 feet to an inch. Henry Belam, Commander R.N., Marine Surveyor, H. G. G. Ashton, F.R.G.S., Assistant Marine Surveyor, Mersey Docks and Harbour Board. *Presented by H. G. G. Ashton, Esq.*

Captain Belam and Mr. Ashton have already produced charts of the approaches to Liverpool and the entrance to the Mersey, containing a large amount of detailed information as regards soundings, the positions of sandbanks, etc., which must have proved most useful to the navigator. They have now issued an additional sheet, showing the course of the Mersey as far as Eastham and Garston. Numerous soundings are given at short intervals, in lines running across the river at right angles to its course, and the positions of lights and sands are clearly indicated.

U.S. Charts. **U.S. Hydrographic Office**

Pilot Chart of the North Atlantic Ocean for November, and of the North Pacific Ocean for December, 1902. U.S. Hydrographic Office, Washington, D.C. *Presented by the U.S. Hydrographic Office.*

PHOTOGRAPHS.

British East Africa and Uganda. **Pereira.**

240 photographs of British East Africa and Uganda. By Captain C. Pereira, Coldstream Guards. *Presented by Captain C. Pereira.*

These photographs are specially interesting from the fact that they represent the country and natives in their primitive conditions before they are changed by the introduction of civilization, which doubtless will soon be the case, now that the railway has been constructed to Victoria Nyanza. The following are the titles:—

(1, 2, 5, and 6) Uganda railway; (3) Mission station garden, Kibwezi; (4) Ox transport, Uganda road; (7) Group of Masai Elmoran, taken at Kikuyu station; (8) Northern slopes of Mount Elgon; (10) Group of Masai; (11) E. J. Berkeley, H.M. Commissioner and Consul-General for Uganda, and group of officers of Uganda Rifles; (12, 13) Wakikuyu warriors; (14) Group of Masai Elmoran at Kikuyu fort; (15) Kikuyu fort; (16–19) Wakamba porters; (20) Masai people; (22 and 29) Thompson's gazelle; (24) Kibwezi fort; (25, 39, 211, and 225) Captain Pereira; (27) Captain Sykes, R.H.A., issuing rations to Swahili Askaris; (28) Bush cat; (31) Nandi fort; (32 and 33) Camp on the Uganda road, Nandi country; (34–37, 40, and 41) Views in the Mau forest; (38) Clearing in Mau forest; (42) Kavirondo medicine man, Mumia's; (43) "Mgeti," Kavirondo chief, and wives, Samia hills; (44) Wa Kavirondo, Mumia's; (45) Canoes at Lubwa's ferry, Victoria Nyanza; (46–49) Lubwa's ferry and Wa Kavirondo porters; (50) Two years' supply, clothing, provisions, and ammunition; (51) Camp, Samia hills, Kavirondo; (52) Swamp, Uganda; (53) Caravan entering Kampala (Mengo); (54–57) Marching through Uganda, trees, grass, and swamps; (58–61) Views in Usoga; (62) View in Uganda; (63) Native bridge over swamp; (64) Pathway in Uganda; (65) Waganda canoes, Victoria Nyanza; (66) Sore-Mbai gorge; (67–69) Views north of Mount Elgon; (70) Rock pools, Birkimani, South Karamo; (71 and 72) Views of camp at Sare, Mount Elgon; (73) Sudanese troops, Uganda Rifles; (74) Officers of Colonel Macdonald's column; (75 and 86) Karamojo and Shooli natives; (76 and 82) Gule camp, Rom hills; (77) Kabiliolh camp, Karamojo; (78) Mount Moroto, from camp in Bukora, near Mumalinga hill; (79) Camp, Titi, Karamojo; (80) Mumalinga camp, Mount Moroto in distance; (81) Camp near Akinyo river; (83 and 84) Karamojo natives; (85) Camp near Mumalinga hill; (87 and 89) Upper Solian; (88 and 90) Views from upper Solian looking towards Kiteng; (91 and 92) Natives of Solian; (93 and 94) Karamojo headgear; (95, 97, and 99) Katu village, Latuka; (96) Maxim gun porters and Sikhs; (98 and 109) Langu natives; (100) Solian camp; (101) Solian hills from Kiteng; (102) Loggouren village on top of kopje, Latuka; (103) Camp; (104) View up valley leading to Tarrangole; (105, 106, and 108) Tarrangole town; (107 and 112) Langu chief; (110 and 117) Sultan of Latuka and natives, Tarrangole; (111) Tarrangole women; (113) Langu chiefs and Dervish Jibba; (114) Latuka headdress; (115) Zanzibari headmen; (116) Loggouren villagers, Latuka; (118) Native guides; (119) Mohomed Ratib Effendi (16th Co. Uganda Rifles), headman Raschid and Farajalla Effendi (16th Co. Uganda Rifles); (120) Sikhs; (121) Women and girls, Latuka; (122) Camp Titi, Dodosi; (123) Titi; (124 and 125)

Views near Titi; (126-129) Caravan on the march, plains of Karamojo; (130 and 131) Kopjes near Titi; (132) Caravan on the march: (133) Captain Kirkpatrick; (134 and 135) General view of Mount Elgon from the north; (136) Mount Moroto; (137) Mount Debasien; (138) Mount Debasien from the south; (139) Expedition fording Nzoia river; (140–143) Officers serving in British East Africa and Uganda—Bright, Pereira, Austin, Hanbury Tracy, McLoughlin, Macdonald, Fergusson; (144 and 145) Market, Mumia's; (146) Kavirondo women; (147) Rifle range, Mumia's; (148, 149, and 152) Native bridge made of creepers near Mumia's; (150 and 153) Wanyamwezi porters dancing; (151) Kavirondo women, funeral dance; (154–156) Port Victoria, Victoria Nyanza; (157) Natives, Port Victoria; (158) Sentry box, 16th Co. Uganda Rifles, Mumia's; (159) Mess hut, Mumia's; (160) Grass hut over tent, Mumia's; (161) Camp at Mumia's, 16th Co. Uganda Rifles; (162) Ferry boat on river Nzoia, near Mumia's; (163) Cyclist, Mumia's; (164) Mwanga, *en route* to the coast after capture; (165) Kabba Rega, *en route* for the coast; (166) Mwanga and Kabba Rega; (167) Kavirondo warriors; (168) View in Ukassa country, Kavirondo; (169 and 170) Ugowe bay; (171) Akela's, near Port Ugowe; (172) Papyrus, Port Ugowe; (173 and 174) Pier built through Papyrus, Port Ugowe; (175–177) Market, Port Ugowe; (178 and 179) Country between Nandi station and Lumbwa's Post; (180 and 181) View from Lumbwa's Post; (182) Nyando valley, Lumbwa's Post, showing camp; (183) Nyando valley near Lumbwa's post; (184) Lumbwa's Post camp, Nyando valley; (185 and 186) Nyando valley, looking east from Lumbwa's Post; (187) Mnara hill near Lumbwa's Post, Nyando valley; (188) Lumbwa's Post camp, Nyando valley; (189 and 190) Nandi chief; (191–193) Wa Nandi warriors; (194–204) Wa Nandi and Wa Lumbwa, Lumbwa's Post, Nyando valley; (205–208) Uganda Railway Survey Camp, Mau plateau—Christmas, 1899; (209) Railway survey party and Captain Pereira; (210) Uganda Rifles, native officers; (212) Some N.C.O.'s, 16th Co. Uganda Rifles; (213) Quarter guard, 16th Co. Uganda Rifles; (214–216) Sections of s.s. *William Mackinnon* being carried to Victoria Nyanza; (217–221) Lake Naivasha; (222) Naivasha fort; (223) View from Naivasha fort; (224) Mount Longonot rift-valley; (226–229) Uganda Railway railhead, January, 1900, Kikuyu escarpment; (230) Mombasa; (231) Mombasa, road to the railway station; (232) Bungalow, Mombasa; (233) Kilindini harbour, Mombasa; (234–238) Zanzibar; (239 and 240) Dar es Salaam.

Fernando Noronha.

Fifteen photographs of Fernando Noronho. *Presented by R. Kaye Grey, Esq.*

These photographs were taken in connection with the landing of the South American cable, with which event several of them are specially concerned. In addition to this, they illustrate very clearly the physical features of the island.

(1) The fort; (2 and 3) The Peak rock; (4) The Peak rock and Fair Brother's rock; (5) The Peak rock, "Caporro" beach and infirmary in foreground; (6) Government offices and cable station; (7) General view of "Villa" (town); (8) South American Cable Company's cable-huts; (9) Landing the South American cable from s.s. *Silvertown;* (10 and 11) Conceicão beach; (12) The "Praca;" (13) General disembarking place, "Caporro" beach; (14) Landing South American cable, Conceicão beach; (15) s.s. *Silvertown* off Fernando Noronha.

Lord Howe Islands. **Brown.**

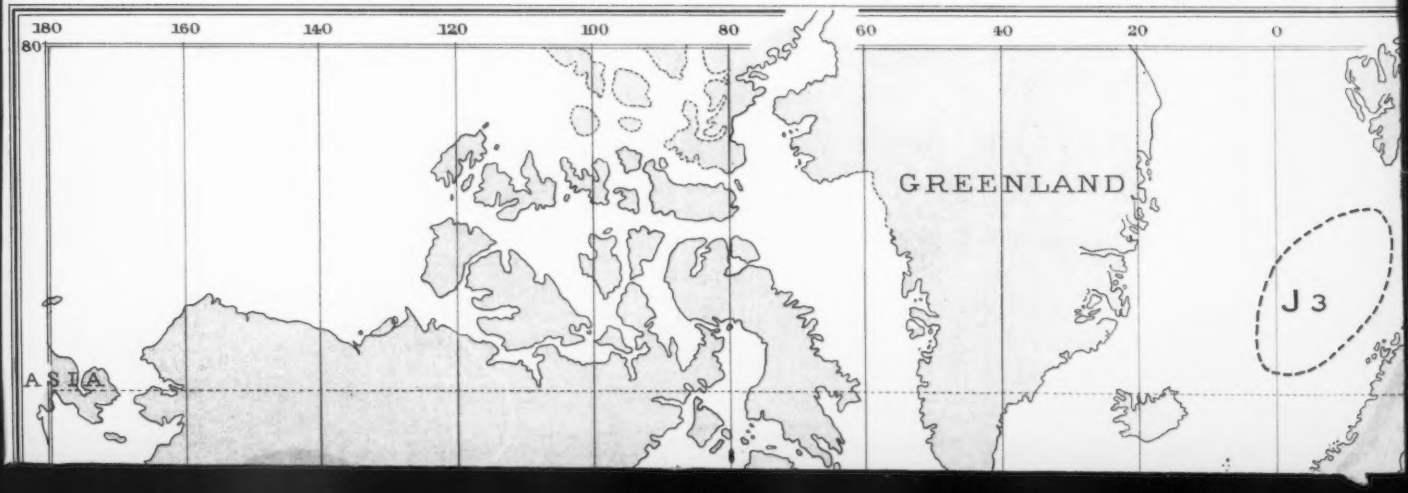
Nineteen photographs of Luanua, Lord Howe islands, taken by Rev. George Brown, D.D. *Presented by C. M. Woodford, Esq.*

Dr. Brown is to be congratulated on these excellent photographs which he has succeeded in taking of this comparatively little-known group of islands. Those of the natives and the native burial-grounds are remarkably good, and the latter are specially interesting.

(1-4) View in village, Luanua; (5) Sacred house containing wooden images, Luanua; (6) View at Luanua; (7–9) Native burial-ground, Luanua; (10) "Uila," chief of Luanua; (11-18) Natives of Luanua; (19) Natives of Luanua (with albino woman).

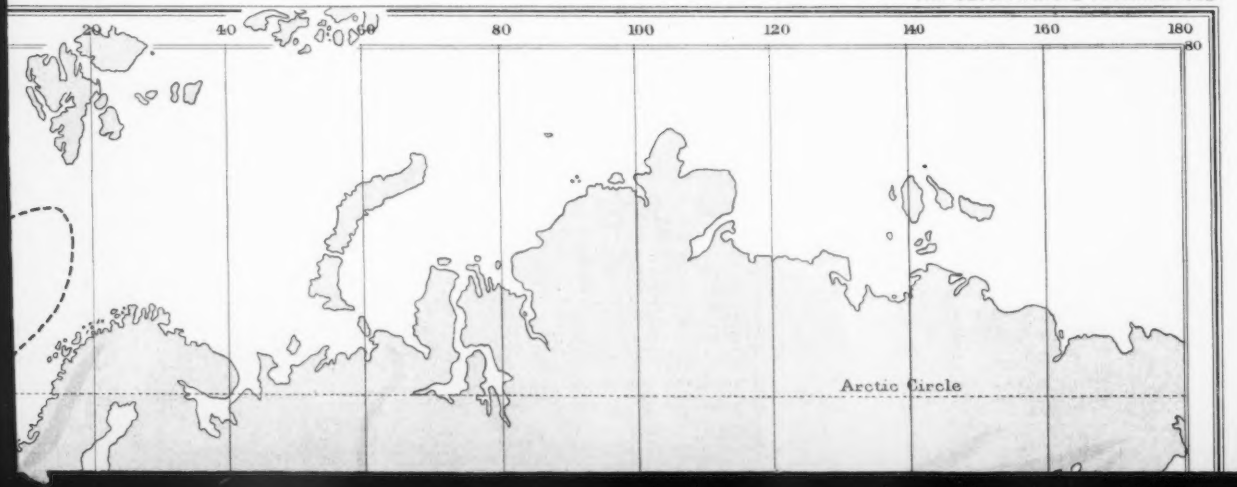
N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.

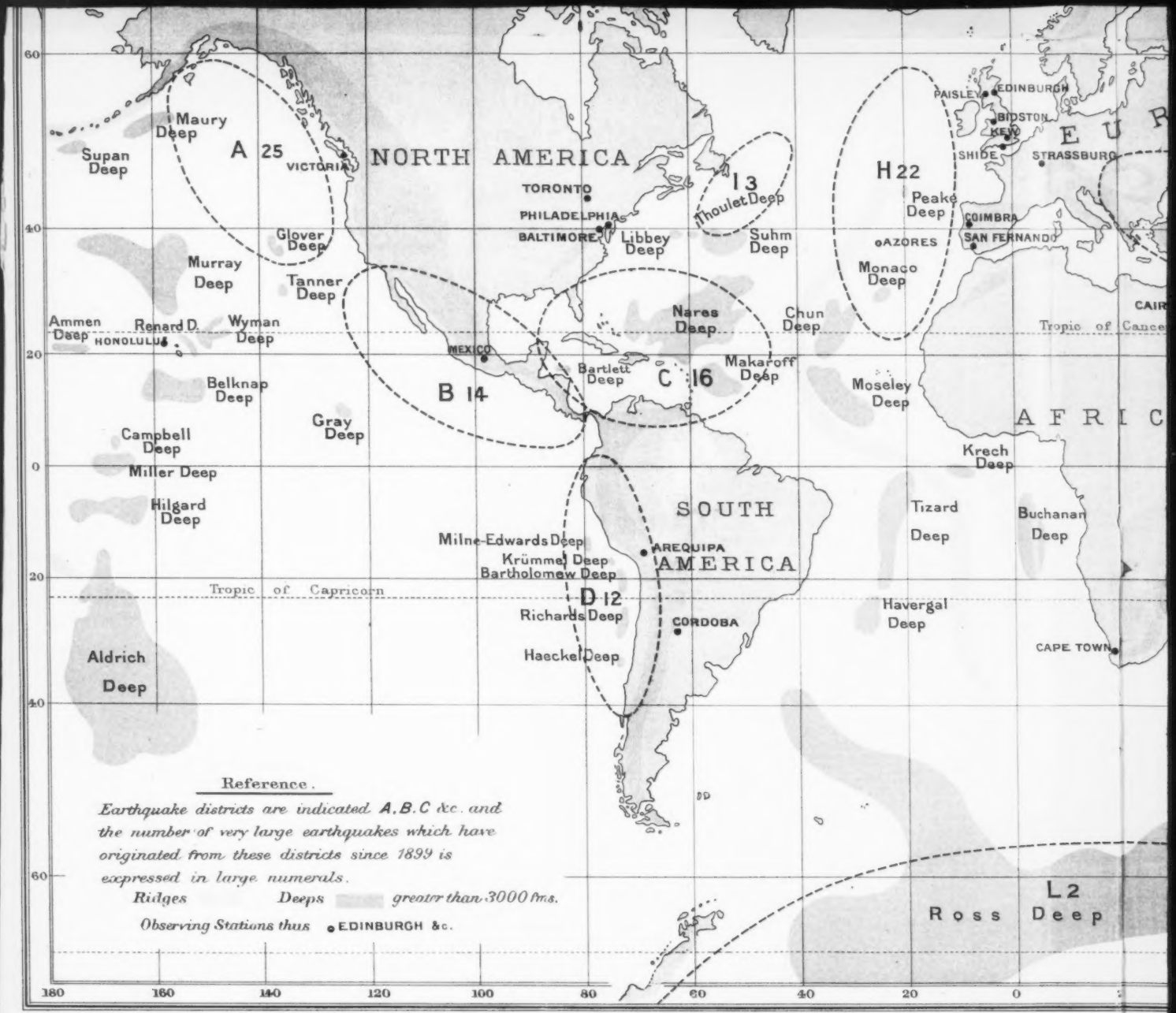
MAP OF THE WORLD TO ILLUSTRATE THE PA



ИВГІС ПВКУБА
ГОЗ ИИСЕГЕЗ

E PAPER BY PROF. J. MILNE, F.R.S.





Reference.

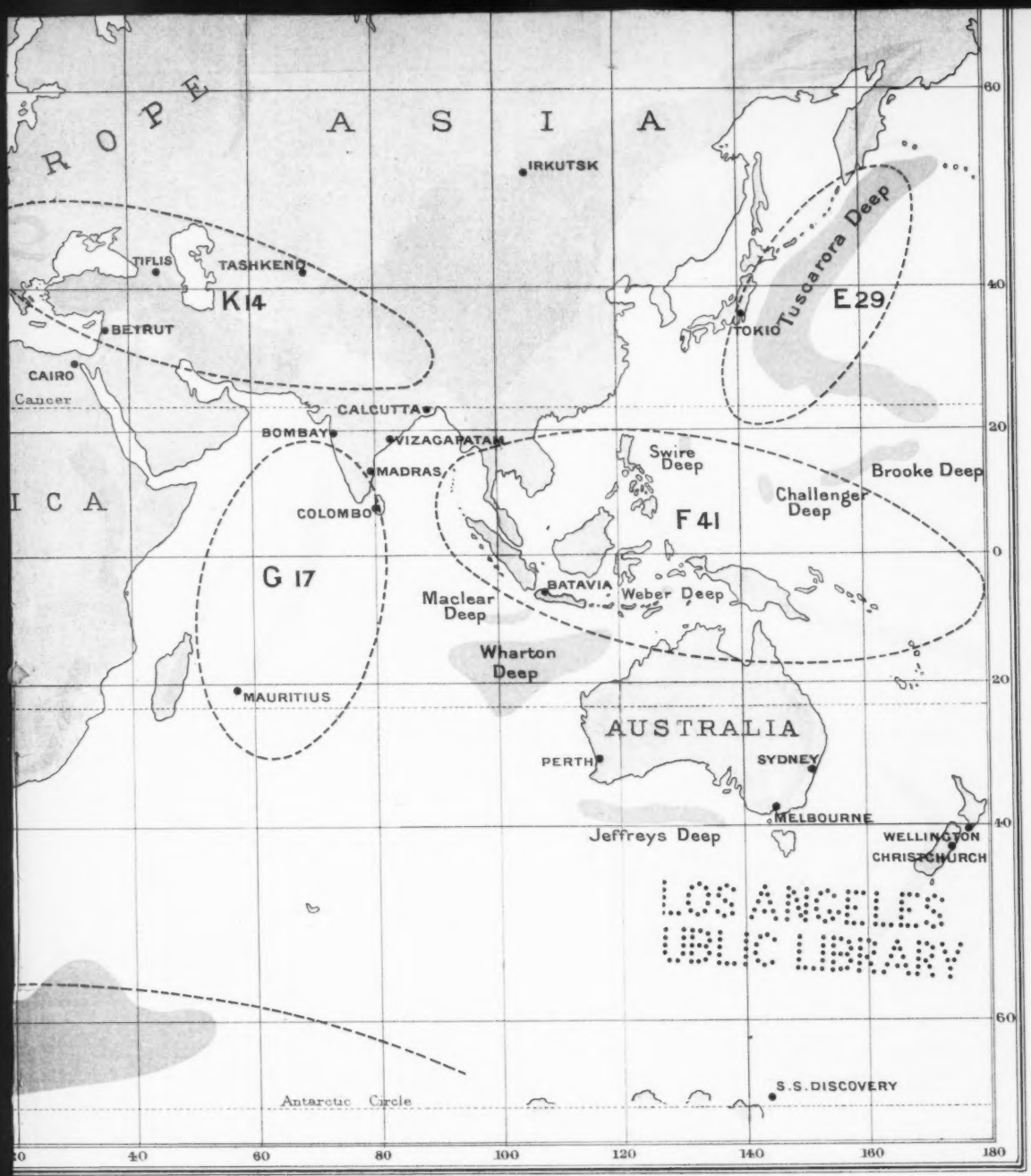
Earthquake districts are indicated A, B, C &c. and the number of very large earthquakes which have originated from these districts since 1899 is expressed in large numerals.

Ridges *Deeps* *greater than 3000 fms.*

Observing Stations thus ● EDINBURGH &c.

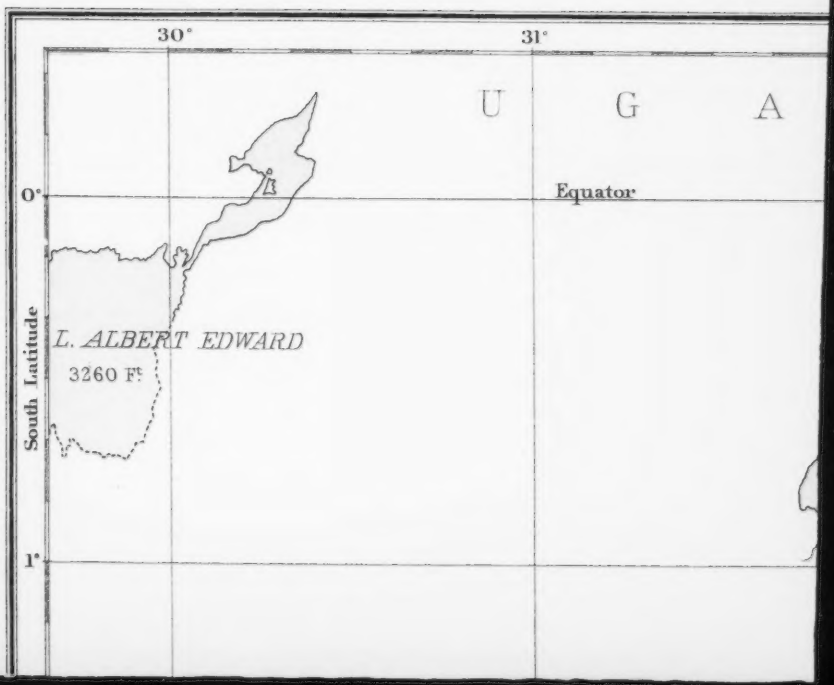
Mercators Projection.

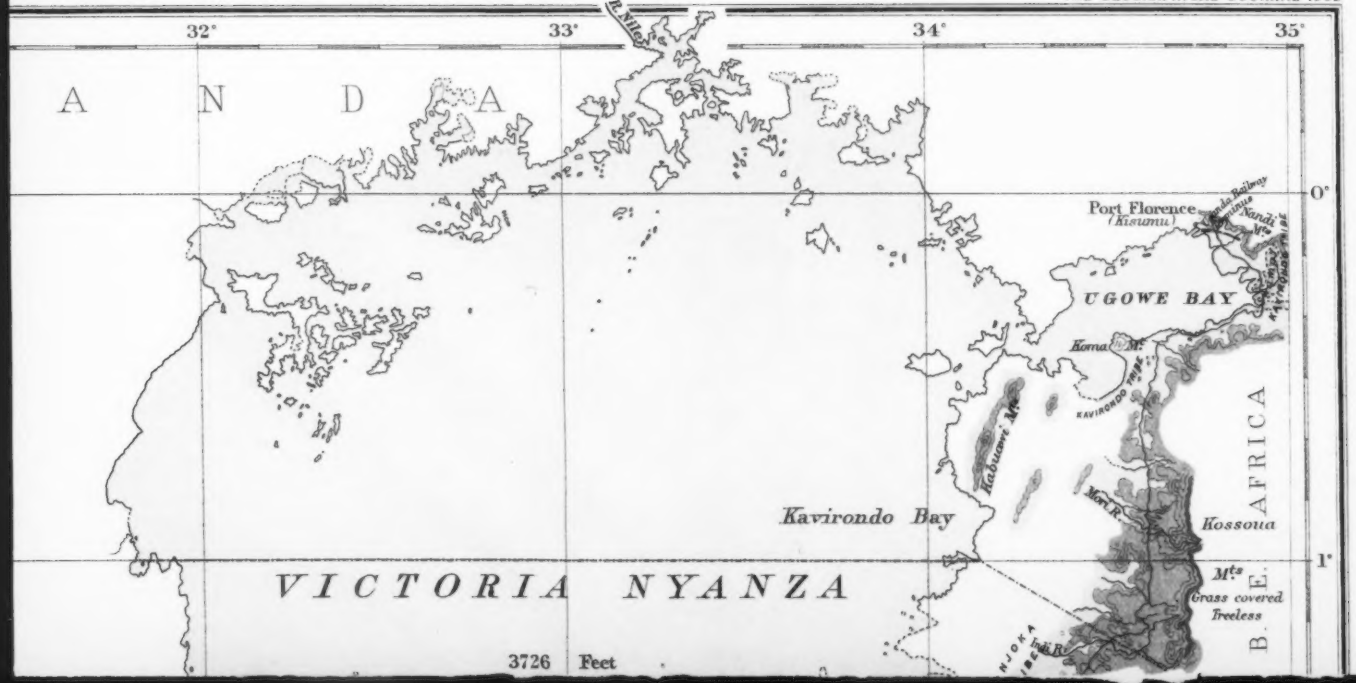
Published by the Royal Geographical Socy.

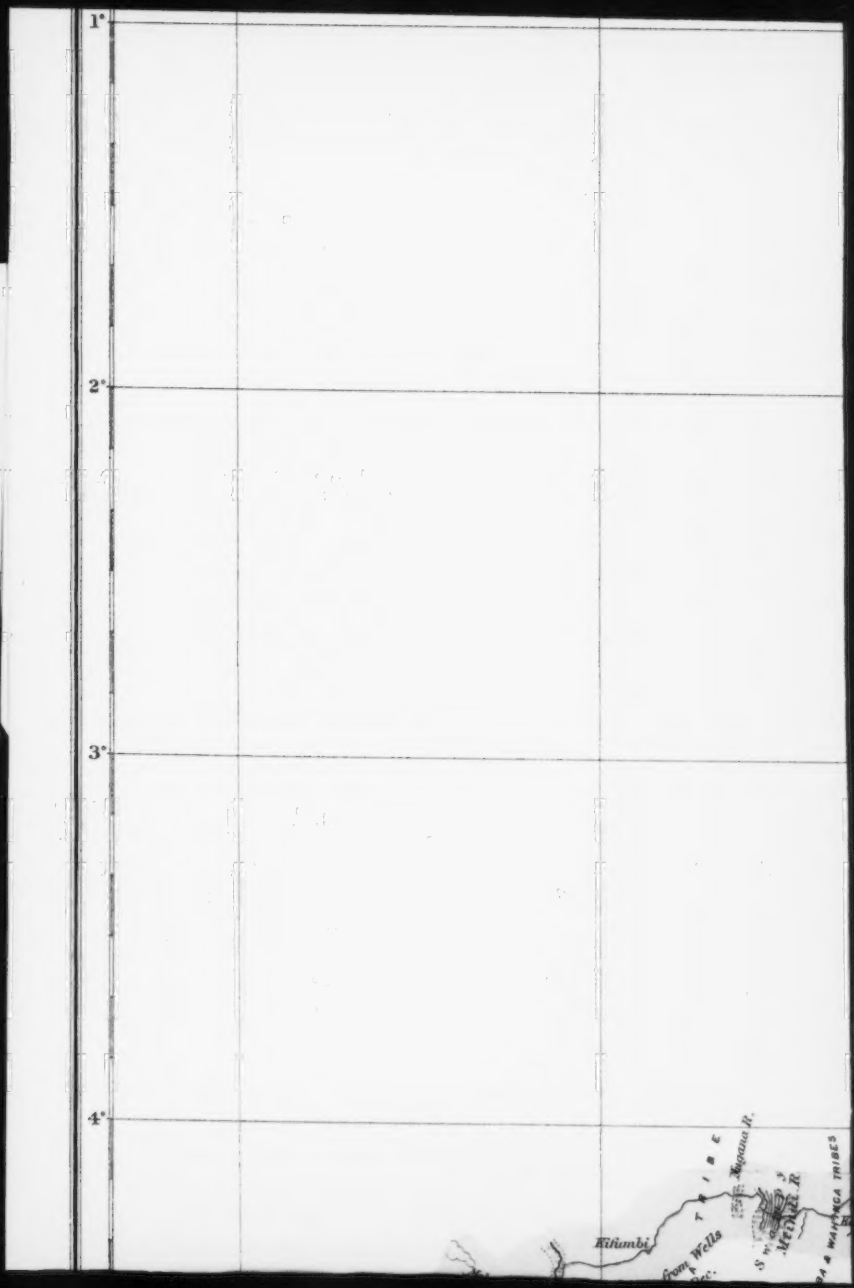


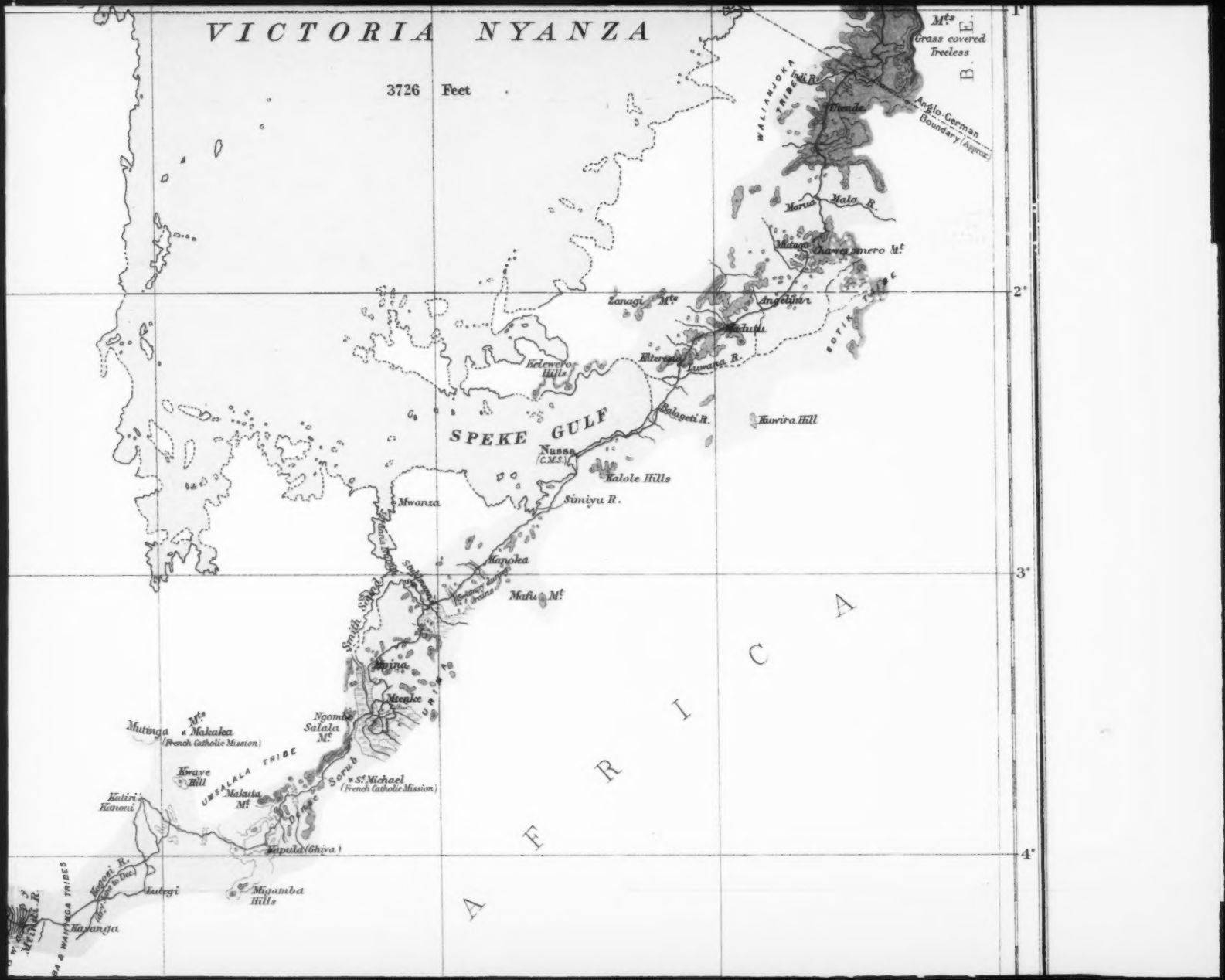
LOS ANGELES
UBLIC LIBRARY

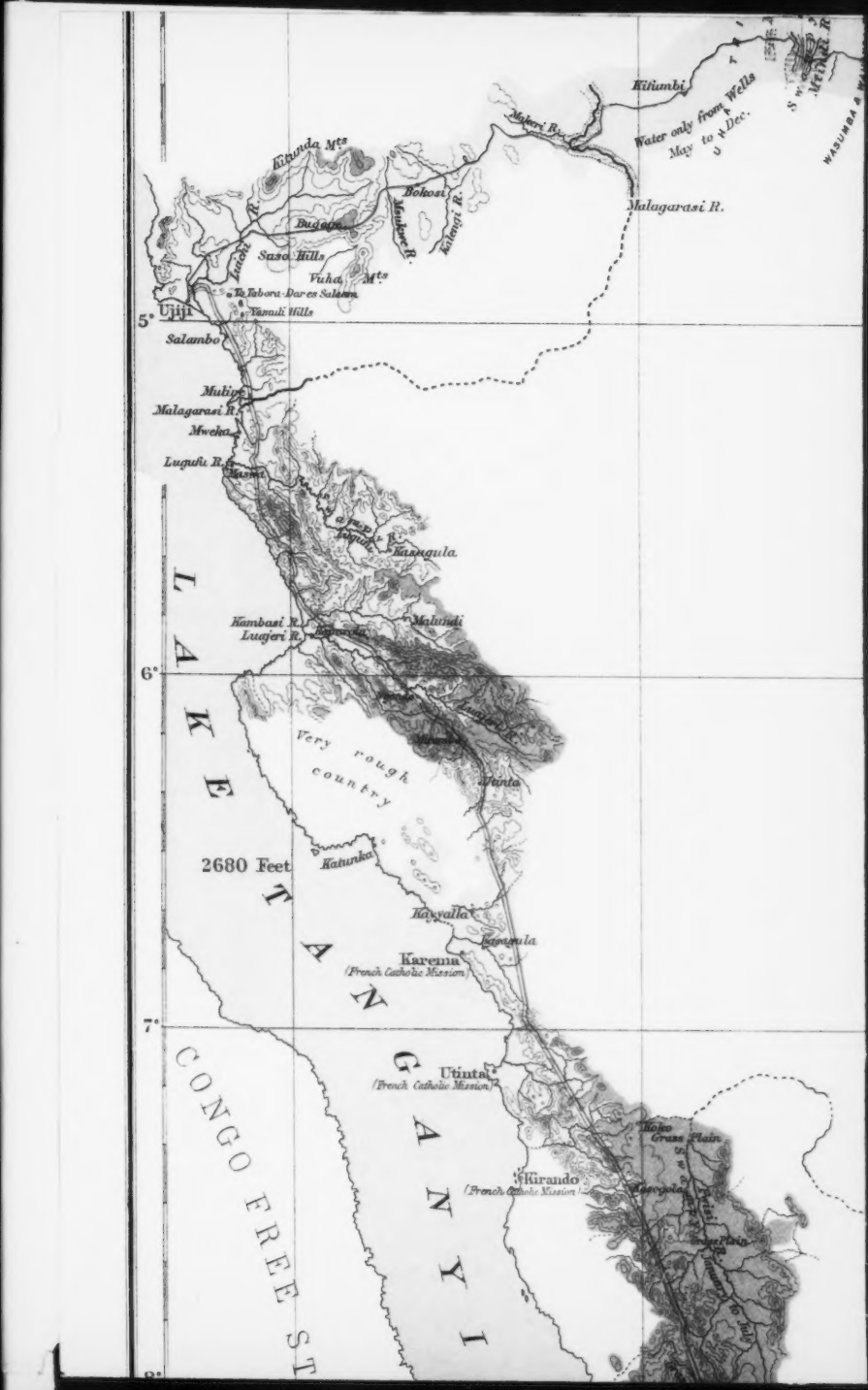
ciety.

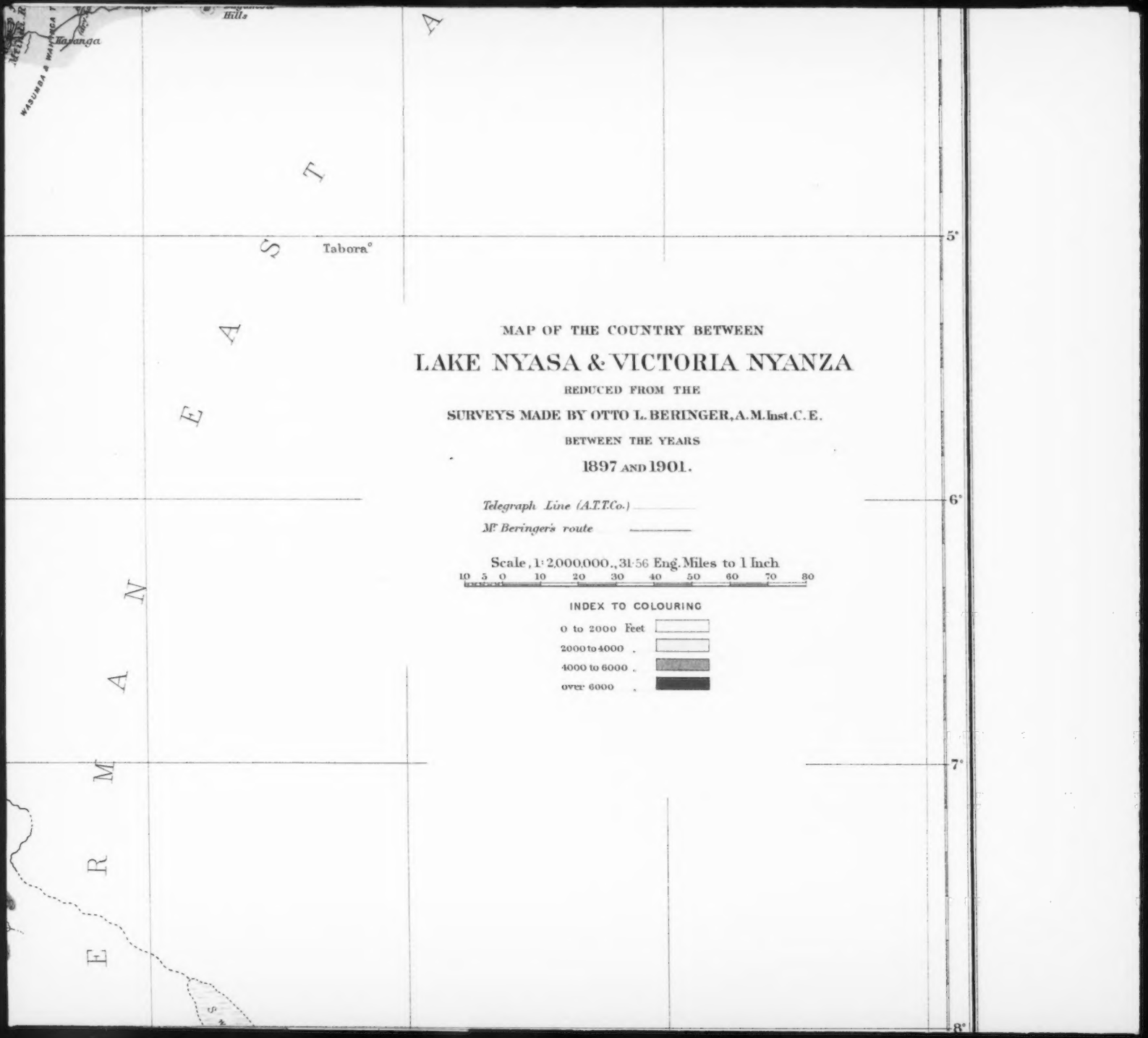

30°
31°
U G A
0°
Equator
L. ALBERT EDWARD
3260 Ft
South Latitude
1°

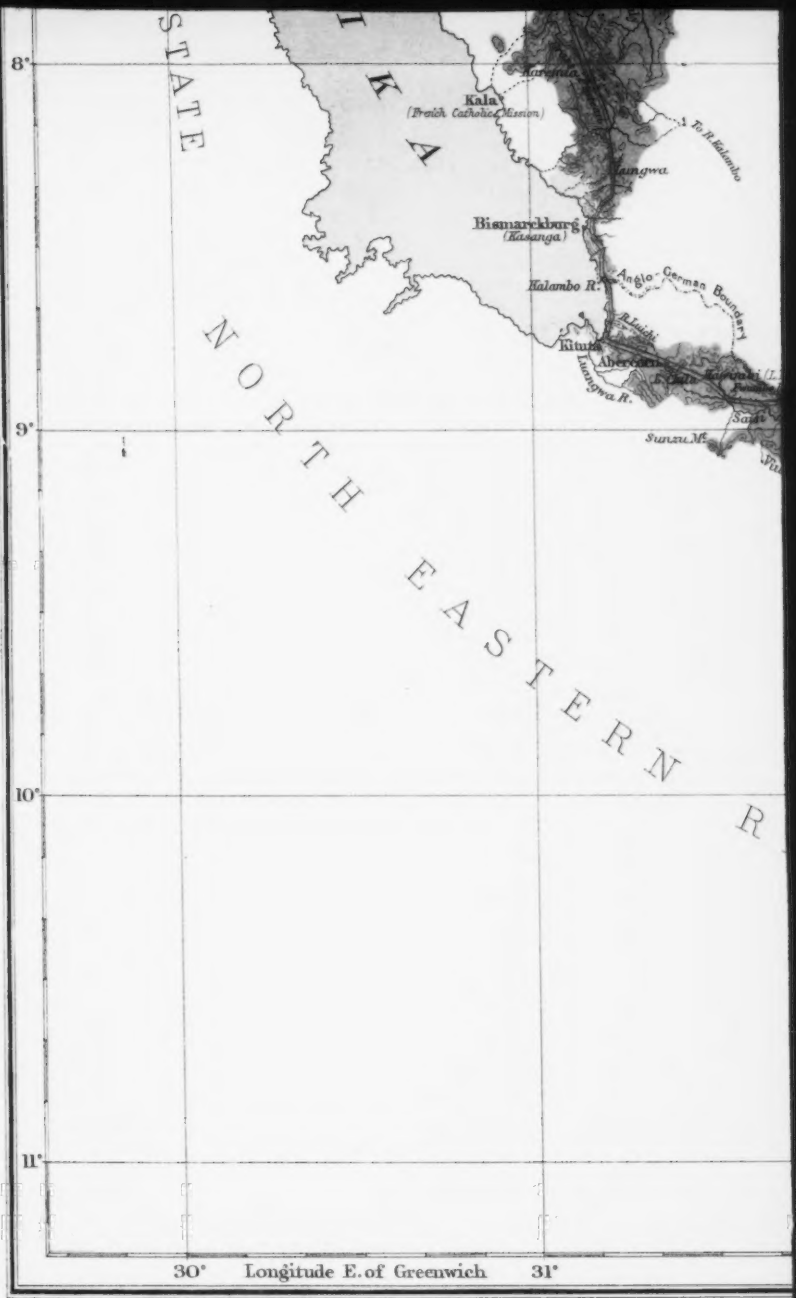

32°
33°
34°
35°
0°
1°
A N D A
R. Nile
Port Florence
(Kisumu)
Nandi
UGOWE BAY
Kisumu Mt.
KAVIRONDO TRIBE
Kavirondo Bay
Kabuswi Mt.
Mau R.
Kossoua
Mts
Grass covered
Treeless
B. E. AFRICA
VICTORIA NYANZA
3726 Feet


1°
2°
3°
4°
Kilimbi
Mgama R.
Wells
&c.
&c.
MEDJE R.
WAMEGA TRIBES

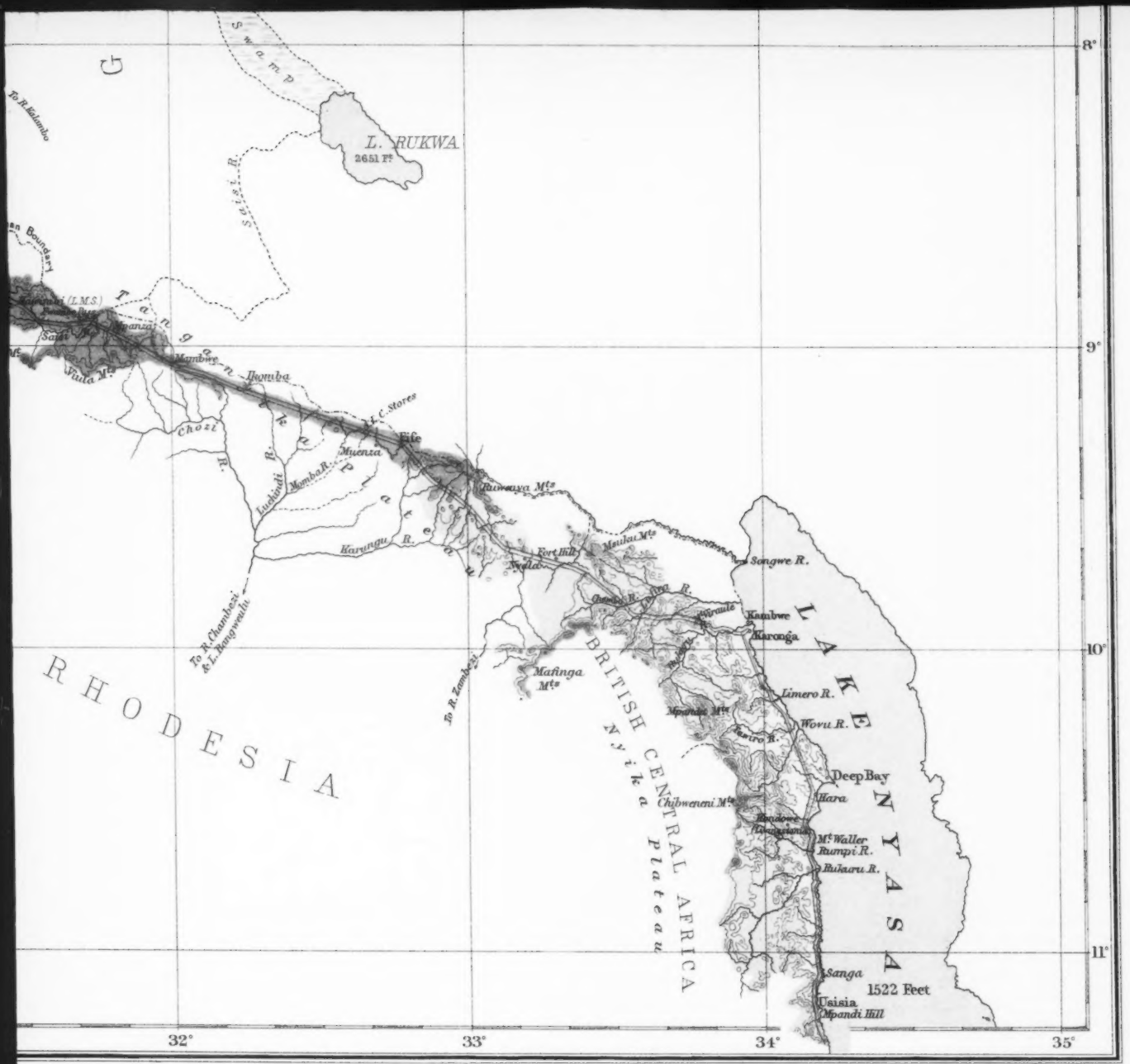

VICTORIA NYANZA
3726 Feet
Mts
(Grass covered
Treeless
B.E.
Wallianjoka Tribe
Ili R.
Uende
Anglo-German
Boundary (Approx.)
Maua
Mala R.
Mutago
Charwa mero Mt.
Zanagi Mts
Angelimi
Kaduru
Kelewelo
Hills
Kitere
Lauraka R.
Sotik Tribe
Salageti R.
Kawira Hill
SPEKE GULF
Nasse
(C.M.S.)
Kalole Hills
Siniyu R.
Mwanza
Kanolea
Mafu Mt
South Kavirondo
Myina
Mtenke
Mutinga
Mts
Makakea
(French Catholic Mission)
Ngombe
Salala
Mt
Ukwaye
Hill
Ugsalala Tribe
Malaula
Mt
Sorab
St Michael
(French Catholic Mission)
Katiri
Kanoni
Kapula (Ghiva)
Kavirondo
Tribes
Kanyai R.
(Dry season only)
Lutegi
Migamba
Hills
Kasanga
Mtera R.
AFRICA
1°
2°
3°
4°


Kihumbi
Water only from Wells
May to Dec.
Mukori R.
Malagarasi R.
Kitunda Mts
Bokosi
Mwakari R.
Kilangi R.
Bugogo
Sasa Hills
Vuha Mts
To Tabora Dar es Salaam
Yanuli Hills
Ujiji
Salambo
Mulipa
Malagarasi R.
Mweka
Lugufu R.
Kasangula
Kambasi R.
Luajeri R.
Malundi
LAKE TANGANYIKA
Very rough country
Ujinta
2680 Feet
Katunka
Kayalla
Karema
(French Catholic Mission)
Utinta
(French Catholic Mission)
Kirando
(French Catholic Mission)
CONGO FREE ST.
Rukwa Grass Plain
Lake Rukwa
5°
6°
7°
8°


Hills
Kayanga
WASUMBA & WANYAMWEZI
E A S T
Tabora
E A
E R M A N
5°
6°
7°
8°
MAP OF THE COUNTRY BETWEEN
LAKE NYASA & VICTORIA NYANZA
REDUCED FROM THE
SURVEYS MADE BY OTTO L. BERINGER, A.M.Inst.C.E.
BETWEEN THE YEARS
1897 AND 1901.
Telegraph Line (A.T.T.Co.)
Mr Beringer's route
Scale, 1:2,000,000., 31·56 Eng. Miles to 1 Inch
10 5 0 10 20 30 40 50 60 70 80
INDEX TO COLOURING
0 to 2000 Feet
2000 to 4000 .
4000 to 6000 .
over 6000 .



Sanson's Sinusoidal Equal Area Projection.



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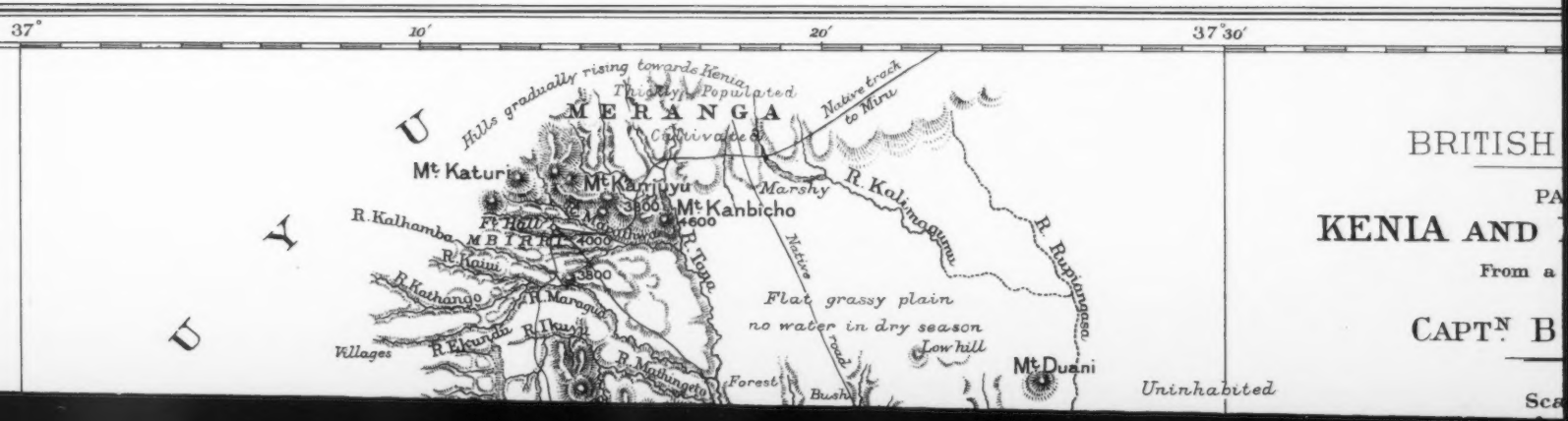
Stanford's Geog.l Estab.t London.

50



BRITISH

PA

KENIA AND

From a

CAPT.N B

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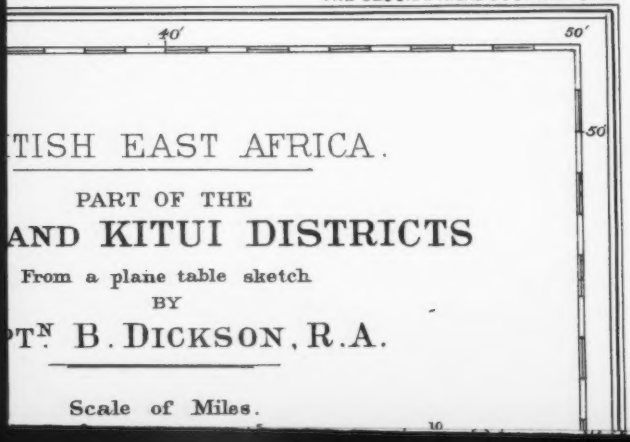
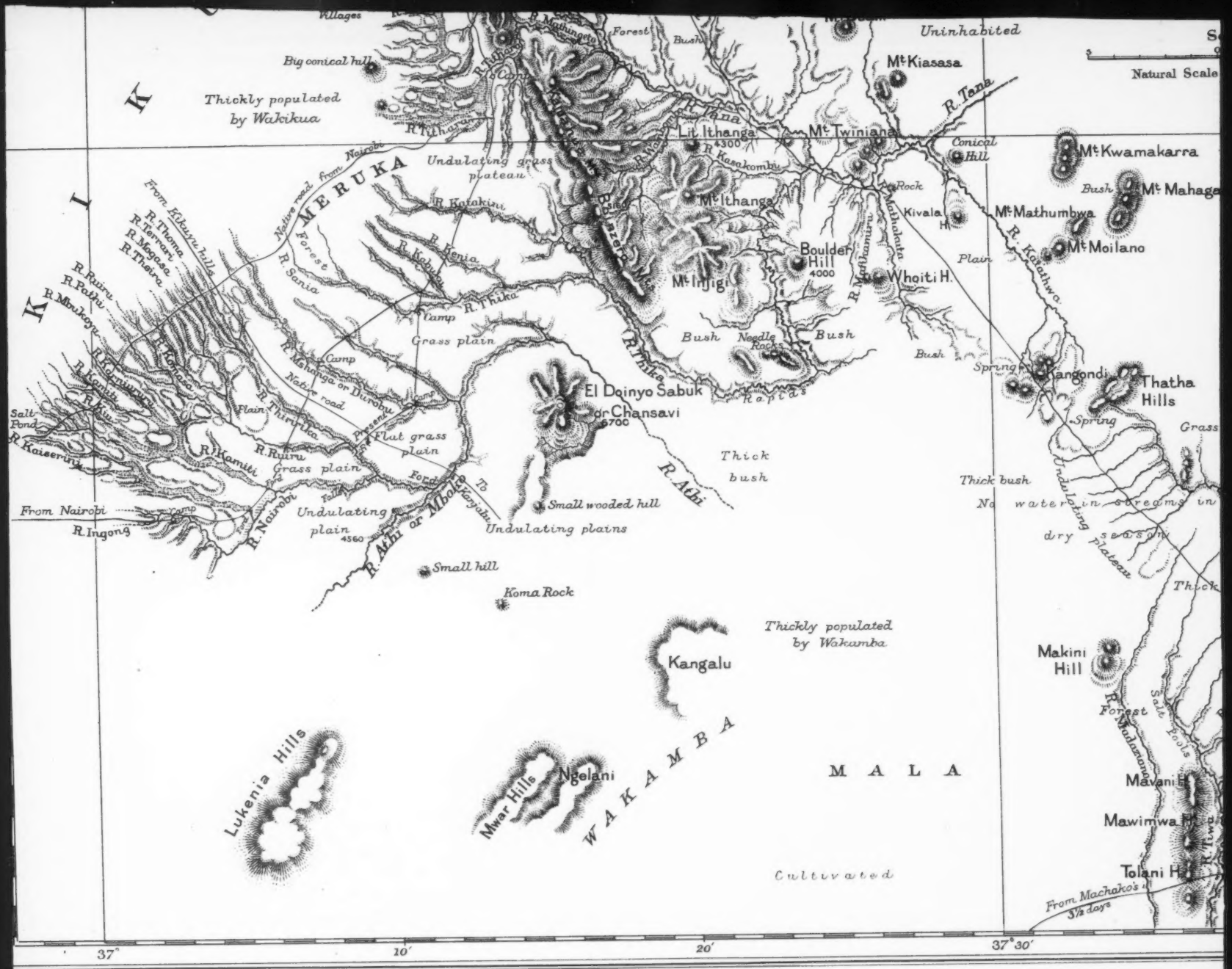
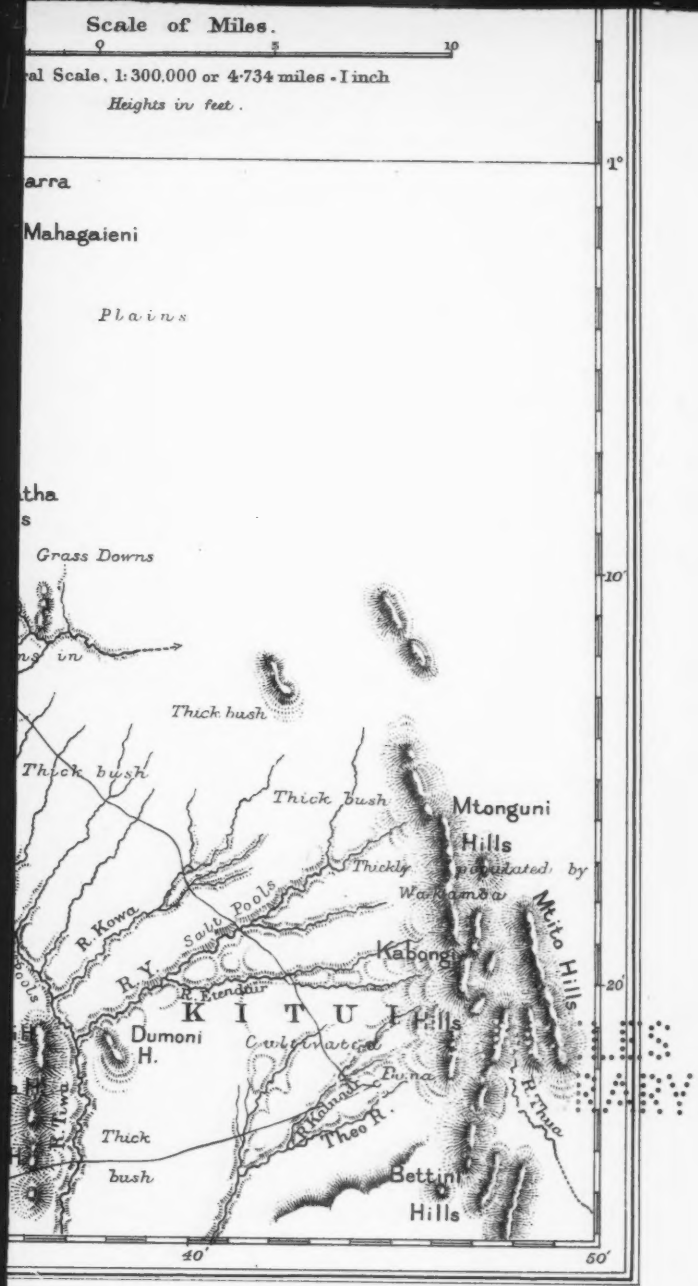

40'
50'
50'
ITISH EAST AFRICA.
PART OF THE
AND KITUI DISTRICTS
From a plane table sketch
BY
PT.N B. DICKSON, R.A.
Scale of Miles.
10

1°
Salt
Pond
10'
20'



Published by the Royal Geographical Society.


Scale of Miles.
0
5
10
ral Scale, 1:300,000 or 4·734 miles = 1 inch
Heights in feet.
arra
Mahagaieni
Plains
tha
s
Grass Downs
ns in
Thick bush
Thick bush
Thick bush
Mtonguni
Hills
Thickly
Wakamba
Salu Pools
R. Kowa
R. Y.
R. Etendaur
Kabongi
Mkito Hills
K I T U I
Hills
Dumoni
H.
Cultivation
Duma
R. Thua
R. Kowa
R. Kalundi
Theo R.
Thick
bush
Bettini
Hills
1°
10'
20'
40'
50'